



# **A Simplified Index of Sustainable Economic Welfare for the Netherlands, 1971-2004**

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## **ABSTRACT**

*This report reviews the compilation of a Simplified Index of Sustainable Economic Welfare (SISEW) for the Netherlands for the period 1971-2004. The SISEW is a simplified version of the Index of Sustainable Economic Growth (ISEW) in that it is comprised of fewer items. Based on the ISEW case study for Belgium, a restrictive criterion is applied to the methodology of the index which omits items with low quantitative significances. This allows for monitoring sustainable economic welfare using less data than previously needed. The simplifying exercise is done for both the original methodology as well as an adjusted one that was developed as a reaction to increased criticism on some of the valuation methods used within the ISEW methodology and a need to make the index more consistent with its theoretical background. As both methodologies result in different trends over time of per capita economic welfare in the Netherlands, the importance of the underlying assumptions within the methodological framework of the index is underlined. It is therefore extremely important that a widely accepted and more robust set of valuation methods is established in the near future, in order to add to the validity of the ISEW as a proper measure of economic welfare.*

## **1 Introduction**

This report reviews the compilation of a Simplified Index of Sustainable Economic Welfare (SISEW) for the Netherlands for the period 1971-2004. The SISEW is a simplified version of the Index of Sustainable Economic Growth (ISEW) by Daly and Cobb (1989) in that it is

compromised of fewer items. Based on the ISEW case study for Belgium (Bleys, 2006), a restrictive criterion is applied to the methodology of the index which omits items with low quantitative significances. This allows for monitoring sustainable economic welfare using less data than previously needed. Depending on the level of restrictiveness, 9 to 13 items need to be calculated in order to arrive at the SISEW (instead of the 20 needed in the compilation of the ISEW).

The simplifying exercise is done for both the original methodology as described by Cobb and Cobb (1994) as well as the adjusted one proposed in Bleys (2007). The latter was developed as a reaction to increased criticism on some of the valuation methods used within the ISEW methodology, e.g. by Neumayer (1999), and a need to make the index more consistent with its theoretical background based on the Fisherian income concept as worked out by Lawn (2003). For Belgium, these refinements have a significant impact on the index, as working with alternative valuation methods results in a non-declining evolution of economic welfare over time. These findings are not in line with the 'threshold hypothesis' (Max-Neef, 1995), which has been put forward following other international studies on the ISEW.

The focus of this report will primarily lie on the original methodology as worked out by Cobb and Cobb (1994) and Jackson et al. (1997). First, the selected items using different levels of restrictiveness will be presented, as well as the underlying rationale for their inclusion in a measure of economic welfare. Next, the exact methodology and the data needed for the different items within the SISEW methodology will be reviewed. Afterwards, the preliminary results for the Netherlands (1971-2004) are presented. Finally, the impact of working with the adjusted methodology will be investigated.

## **2 The Simplified Index of Sustainable Economic Welfare**

Daly and Cobb (1989) constructed the Index of Sustainable Economic Welfare (ISEW) to offer an alternative measure of economic welfare. They first put forward the index in their influential book 'For the Common Good: Redirecting the Economy Toward Community, the Environment, and a Sustainable Future'. Here, the methodology was outlined and the index was compiled for the United States (1950-1986). Five years later, Cobb and Cobb (1994) revised the methodology, adding new items to it and incorporating new valuation methods. Their work became the foundation for the international research in measuring economic welfare. The Genuine Progress Indicator (GPI) was constructed at Redefining Progress (Anielski and Rowe, 1999) and basically adds a few items to the ISEW methodology (e.g. costs of overwork, costs of family breakdown, ...). The Simplified Index of Sustainable Economic Welfare (SISEW) proposed here is a simplified version of the ISEW in that it is compromised of fewer items.

The ISEW case study for Belgium (Bleys, 2006) is taken as a starting point for determining the quantitative significance of the different items in the ISEW methodology. I have calculated the average percentage of each item to the total of positive or negative items within the index, and based on these percentages, three versions of the SISEW are defined. SISEW1 includes all items that represent more than 1% of these totals, SISEW2 includes those that represent

more than 3% and SISEW those that represent more than 5%. Table 1 gives an overview of the different items that each of these SISEW versions are compromised of.

The basic methodology used to calculate the ISEW and SISEW can be summarized as follows (Jackson et al., 1997):

- ISEW = personal consumption expenditures
  - losses from income inequality
  - + value of domestic labour
  - + non-defensive public expenditures
  - defensive private expenditures
  - costs of environmental degradation
  - depreciation of natural capital
  - + capital adjustments

Personal consumption expenditures are taken as a starting point for the calculation of the index, as these expenses are equivalent to the value placed by consumers on the goods and services they consume - at least, in a perfect equilibrium market - and they can therefore be interpreted as a measure of current welfare derived from today's production. Yet, Daly and Cobb (1989) acknowledge that, although consumption is certainly a more appropriate measure of welfare than production, taking consumption as a basis for a welfare measure remains questionable given the diminishing welfare returns of increases in consumption. They are also unhappy about the fact that the ISEW does not take any account of the relative level of wealth or consumption. Nevertheless, personal consumption expenditures provide at least some indication of the amount of money which consumers are willing to pay for (and hence the value they assign to) the goods and services through which welfare may be provided (Jackson et al., 1997).

Income inequality is factored in on the assumption that an additional and equal amount of money adds more to the welfare of a poor family than it does to a rich family. Yet, this widely supported thesis is not reflected in the national accounts and it urges Daly and Cobb (1989) to incorporate income inequalities in their ISEW, as they argue that the separate treatment of inequalities and the magnitude of economic welfare should be abandoned. In the original ISEW, the Gini coefficient is used to calculate the welfare losses from income inequality, yet subsequent studies have favoured the use of the Atkinson index, as it explicitly states the preference for an equal distribution of income.

The idea of including the production of goods and services by members of a household is intuitively compelling, but the calculation of the item is not very straightforward. As many of the household activities occur outside the market boundaries, their contribution to economic welfare will not appear in the national accounts. Yet, these domestic activities (unpaid productive work) have an important economic significance and both Agenda 21 and the latest update of the System of National Accounts (SNA, 1993) plead for the publication of data on domestic labour. Further, a shift of activities away from the household realm to the market (e.g. paid

Item	Impact	SISEW1 <sup>a</sup>	SISEW2	SISEW3	Rationale
Personal Consumption Expenditures	+	x	x	x	Personal Consumption Expenditures
Losses from Income Inequality	-	x	x	x	Welfare Effects of Income Inequality
Value of Household Work	+	x	x	x	Domestic Labour
Public Expenditures on Health & Education	+	x	x	x	Non-Defensive Public Expenditures
Private Expenditures on Health & Education	-	x			Defensive Private Expenditures
Costs of Commuting	-	x	x		Defensive Private Expenditures
Costs of Water Pollution	-	x			Environmental Degradation (Direct)
Costs of Air Pollution	-	x	x	x	Environmental Degradation (Direct)
Depletion of Non-Renewable Resources	-	x	x	x	Natural Capital Depletion
Costs of Climate Change	-	x	x	x	LT Environmental Degradation
Costs of Ozone Depletion	-	x	x	x	LT Environmental Degradation
Net Capital Growth	+/-	x	x	x	Capital Adjustment
Change in Net International Position	+/-	x	x	x	Capital Adjustment
		> 1%	> 3%	> 5%	

Table 1: Components of the different versions of the Simplified Index of Sustainable Economic Welfare

<sup>a</sup>Five ISEW items are not included in SISEW1: costs of personal pollution control, car accidents and noise pollution, adjustments for consumer durables and loss of farmlands

housekeeping and childcare, restaurant meals and take-away food) will wrongly appear as a welfare gain in the national accounts, so that GDP risks to overstate the actual welfare level in a country. Practical problems arise from the definition of household labour, its measurement and its valuation. Reid (1977) uses his 'Third Man Criterion' to define household labour as those activities that can be performed by a third person (paid or unpaid) without changing the results. The total number of hours spent on housework is derived through surveys on time use, while valuation is based on a shadow price (average wage rate of household personnel).

Public expenditures are considered to be mainly defensive: "the growth of government programs does not so much add to net economic welfare as prevent deterioration of well-being by maintaining security, environmental health and the capacity to continue commerce" (Daly and Cobb, 1989). Only half of the expenditures on higher education and on health are considered as consumption and hence contributing to welfare, as most of these expenditures are thought of as investments in human capital (which is not included in the ISEW framework). Although this methodology is used in most international ISEW studies, some exceptions exist. In the calculation of the GPI for Australia (Hamilton and Denniss, 2000), for instance, substantially more public expenditures are considered to promote welfare.

Defensive expenditures are expenditures that are made to offset a decrease in welfare (Leipert, 1989). Common examples of defensive expenditures include locks and security systems, hospital bills from car accidents and personal water filters. Defensive private expenses are to be subtracted from the consumption base of the ISEW, as they have already been included in it. The ISEW makes adjustments for expenditures on health and education, the costs of commuting, personal expenditures on pollution control, the costs of noise pollution and the costs of car accidents (Cobb and Cobb, 1994). Consistent with the treatment of public expenditures on health and higher education, half of the private expenditures on these items are subtracted. Costs of commuting, pollution control and car accidents (material part) are defensive as they are made in order to maintain a certain lifestyle. As most of these adjustments do not have a significant impact on the overall evolution of the index, only private expenditures on health and education and the costs of commuting are subtracted in the SISEW.

Capital adjustments are needed in order to properly deal with consumer durables and to keep track of net capital growth. Durable consumer goods should be regarded as a capital stock: the annual services delivered by this stock are important and not the annual expenditures on these goods. However, as this adjustment, although theoretically appealing, accounts for less than 1% of the total of all negative adjustments, it is excluded from the SISEW compilation. In order to calculate the net capital growth, Daly and Cobb (1989) introduce a 'growth requirement' that is defined as the amount of investments necessary to compensate for human-made capital depreciation and population growth. Annual net capital growth equals the annual capital growth minus this growth requirement. Besides these adjustments, Daly and Cobb also include an item (changes in the net international investment position) that takes into account whether the source of capital can be sustained on the assumption that sustainability requires long-term national self-reliance.

The ISEW keeps track of environmental damage in two ways. First there are items that reflect the direct effects of water and air pollution, based on estimates of emission trends and damage costs. In the national accounts, these costs are either ignored or treated as a gain. A second category consists of estimates of long-term environmental damage from climate change and ozone depletion. These damages are assumed to be cumulative and directly related to energy consumption and consumption of CFCs respectively.

The availability of natural resources is also incorporated in the ISEW since current natural capital depletion impoverishes future generations. Daly and Cobb (1989) reject the idea of discounting the effects of resource depletion and instead propose the view that “any reduction in economic welfare in the future below the level currently enjoyed should be counted as if the cost occurred in the present”. Within the ISEW, an estimate of the amount of money that would need to be set aside in a perpetual income stream in order to compensate future generations for the loss of services from non-renewable energy resources, is deducted. In addition, the value of lost biological resources such as wetlands and farmlands is factored in. Because of their low quantitative significances, both the loss of farmlands and the loss of wetlands are not included in the SISEW.

In practice, the ISEW is the result of a lengthy series of adjustments to the personal consumption expenditures. For a more detailed review of the methodology Cobb and Cobb (1994) or Jackson et al. (1997) can be consulted. The Genuine Progress Indicator (GPI) adds a number of new items to the ISEW methodology: the value of volunteer work and the costs of crime, family breakdown, unemployment, underemployment and overwork (or the loss of leisure time).

### **3 Methodology and Data**

This section will discuss the data and methodology used to compile the different items of the SISEW for the Netherlands. The column numbers used below refer to table 8 and 9, which contains the full set of estimates used in the compilation of the Dutch SSEW for the period 1971-2004.

#### **Deflators and Exchange Rates**

All monetary estimates used in the SISEW are expressed in constant prices (2000€) using the appropriate deflators. For all items, the implicit GDP deflator, the ratio between published figures on GDP at current prices and GDP in 2000 prices (available on the CBS StatLine website<sup>1</sup>) is used. Exchange rates are also taken from the CBS StatLine website, yet data collection in this area is done by the International Monetary Fund. Monetary values expressed in a foreign currency (e.g. 1972\$) are transformed to 2000€'s by first applying the appropriate exchange rate (e.g. 1972\$ to 1972€) and afterwards the GDP deflator for the Netherlands (e.g. 1972€ to 2000€).

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<sup>1</sup><http://statline.cbs.nl/>

## Column A - Year

The Dutch SISEW was calculated for the period 1971 to 2004, as gathering the necessary data for years prior to 1970 proved very difficult. A lack of environmental data in the 1970s and 1980s asked for some creativity in order to extend the time series of available data to cover the whole time frame of the study. Improvements to this SISEW study are thus easily possible and hence the report should be thought of as a first attempt leading to preliminary results.

## Column B - Personal Consumption Expenditures

Data on personal consumption expenditures are taken from the Dutch national accounts (available on the CBS StatLine website) and are deflated using the implicit GDP deflator. However, as these expenditures are expressed in market prices and not in factor prices, they include certain indirect taxes and subsidies. On one hand, it can be defended that this is a good thing, as market prices fully reflect what people are willing to pay for the goods and services they consume. On the other, working with these expenditures comes with a potential risk of double-counting, when funds raised through these types of indirect taxation are included in the calculation of government expenditures. Since it is very difficult to make ad hoc adjustments to the reported figures in order to convert them into factor prices, most ISEW studies work with the expenditures from the national accounts (in market prices) and deliberately exclude certain government expenditures in an attempt to avoid double-counting.

## Column C - Losses from Income Inequality

In the past, different indexes have been used to factor in income inequality in the ISEW. The original American ISEW uses the Gini coefficient, while more recent studies favour the use of the Atkinson index, as working with the former lacks a clear welfare theoretic interpretation. In contrast to most other measures of inequality, the Atkinson index recognizes that a measure of income inequality should not only reflect the distribution of income between different income groups, but also a society's preference for more or less equality. This preference is expressed through the parameter  $\varepsilon$  (in formula 3.1), that can be interpreted as the amount of money that a society is willing to see lost in the process of transferring income from a richer person to a poorer (Atkinson, 1975). Cowell and Gardiner (1999) describe an approach to determine how these social attitudes are revealed by public redistributive instruments, such as income taxes. This method has already been used in the calculation of the Australian GPI (Hamilton and Denniss, 2000), where the authors arrived at a value of 0.83 for  $\varepsilon$ . This type of analysis has not yet been conducted for the Netherlands, although it would certainly add to the validity of the SISEW. At the moment, a value of 0.8 is used for  $\varepsilon$ . This is the identical value as the one used in the UK study (Jackson et al., 1997), which was suggested by Pearce and Ulph (1995) as the best estimate from their estimated range of 0.7 to 1.5.

The Atkinson index of inequality is calculated as follows (Atkinson, 1970):

$$I = 1 - \left[ \sum_i \left( \frac{Y_i}{\mu} \right)^{1-\varepsilon} f(Y_i) \right]^{\frac{1}{1-\varepsilon}} \quad (3.1)$$

where  $Y_i$  is the mean income of the  $i$ -th interval,  $\mu$  is the mean income of the entire population,  $f(Y_i)$  the proportion in interval  $i$  and  $\varepsilon$  is a measure of the degree of inequality aversion.

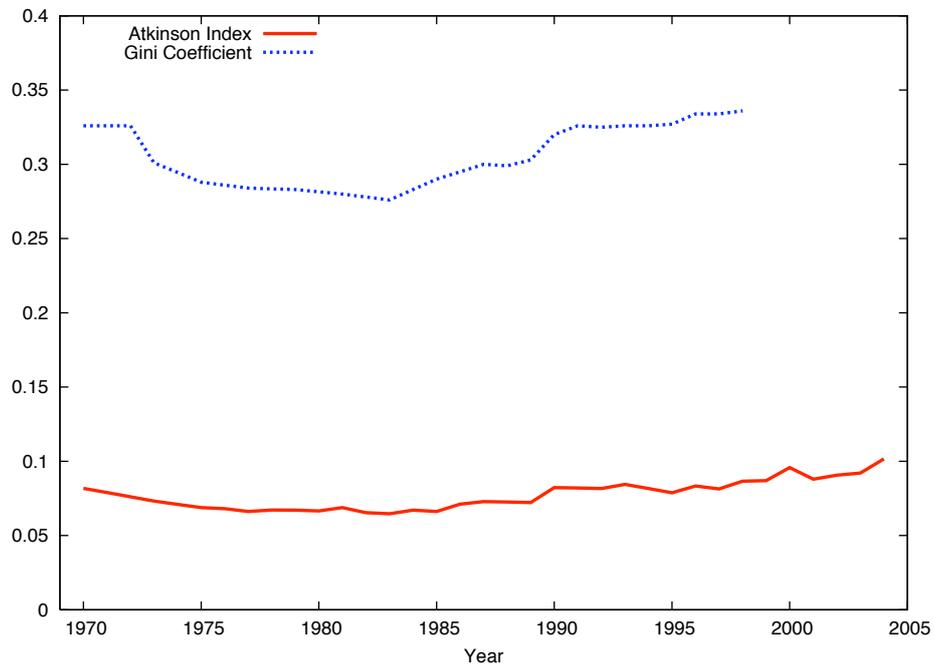


Figure 1: Measures of Income Inequality

Year	Atkinson Index	Gini Coefficient
1975	0.0662	0.284
1980	0.0688	0.280
1985	0.0662	0.290
1990	0.0722	0.303
1995	0.0845	0.326
1990	0.0880	0.334

Table 2: Measures of Income Inequality

Data on the distribution of income (for population deciles) for the Netherlands were given by the Centraal Bureau voor Statistiek (CBS) for 1977, 1981, 1985, 1989-2004. These figures are used to calculate  $I$ , the Atkinson index of income inequality. Values for all other years are obtained through linear regression using the Gini coefficients calculated for the Netherlands (also from CBS). Both indexes of income inequality are depicted in figure 1, while values for specific years can be found in table 2. Notice that the indexes show a similar evolution in time, but that there are differences in absolute terms and that the income inequality in the Netherlands is increasing since 1985.

Welfare losses from income inequality are obtained after multiplication of the private consumption expenditures by the Atkinson index and have to be subtracted from the original expenditures.

## Column D - Value of Household Labour

Unpaid household work makes a large contribution to economic welfare and should therefore be included in any welfare measure. Yet practical problems arise from the definition of household labour, its measurement and its valuation. I have followed the methodology of most other studies on the ISEW to overcome these problems, starting with the adaption of the 'Third Man Criterion' (Reid, 1977) to define household labour as those activities that can be performed by a third person (paid or unpaid) without changing the results. Household labour is valued on the basis of its inputs (number of hours spent on household work) using the average wage rate of domestic workers for the actual valuation, as most studies on the ISEW do.

Time use data for the Netherlands were collected for the years 1975, 1980, 1985, 1990, 1995, 2000 and 2005 by the Sociaal en Cultureel Planbureau (SCP) and are given in 'De Tijd als Spiegel' (Breedveld et al., 2006). From these data, it is possible to calculate how many hours on average a person in the Netherlands spends on household labour (cooking, cleaning, childcare, ...). Data gaps are filled by linearly spreading the differences in time spent on household work over the different time periods. For the periode 1970-1975, it as opted to work with the 1975 data. Next, the annual total numbers of hours spent on household work are calculated for all years, using data on the population between 18 and 75 years from CBS.

Year	Household Work minutes/week	Population 18-75 years	Domestic Worker current €/hour	Value million 1995 €
1975	1302	8934867	2.61	60482.8
1980	1296	9595715	3.22	55443.3
1985	1308	10222369	3.75	56670.9
1990	1206	10837147	4.08	58297.7
1995	1224	11266768	4.89	65639.9
2000	1200	11514790	5.77	69147.5

Table 3: Imputed Value of Household Work - 1975 to 2000

The shadow price (wage rate of cleaning personnel) for the year 2000, which is used in the valuation of household services, is taken from the Belgian ISEW case study. This point estimate is spread over the entire period 1971-2004 using a combination of CPI data on household personnel (1995-2004) and cleaning (1971-2004). Next, these shadow prices are applied to the total numbers of hours spent on household work in each year, in order to arrive at the value of household labour for these years. Table 3 presents all data for the years in which a time use study was conducted. As becomes clear from the figures, time spent on household labour has fallen over the period of this study.

## Column E - Non-defensive Public Expenditures on Health and Education

Most public expenditures are not considered to add to economic welfare, as they are thought of as being largely defensive by nature: most of the expenditures are made to prevent deterior-

riation of well-being by maintaining security, environmental health and the capacity to continue commerce (Daly and Cobb, 1989). The only categories that enter the ISEW methodology are expenditures on health and on education and they only do so partly. From a welfare point of view, these expenditures constitute of a consumption part and an investment part.

The consumption part reflects the actual welfare gain and is therefore to be included in the ISEW. For example, expenditures on adult education might fall into this category as these contributions seek to stimulate leisure activity rather than the acquisition of skills for the job market (Jackson and Stymne, 1996). Yet most of the expenditures on health and education can be thought of as investment in human capital, which is excluded from the ISEW because of measurement problems.

Daly and Cobb (1989) argue that at least part of these expenditures should be regarded as 'defensive'. For education expenditures, they build their argument on the 'Job Competition Model' (Thurow, 1975), in which education is appreciated not for the skills it brings about, but for placing the individual higher in the labour queue than others: "in effect, education becomes a defensive expenditure necessary to protect one's market share". Health expenditures on the other hand can be partly regarded as defensive against accidents and environmentally-related illnesses incurred as a result of economic activities. In most ISEW studies half of the public expenditures on higher education and on health are taken to reflect the non-defensive consumption part of public expenditures.

The Dutch SISEW methodology treats public consumption expenditures more or less in the same way as the original ISEW: half of the expenditures on health and on all types education are included (where the American ISEW takes only half of the expenditures on higher education). This adjustment was made because of problems with data availability, yet I hope to find more accurate data on expenditures on higher education in the future. The CBS StatLine website offers data on public consumption expenditures on education and health ('medical and social services') for the period 1995-2004. Earlier data of the time series are estimated using the average ratio of the health and education expenditures to the total public consumption.

### **Column F - Defensive Private Expenditures on Health and Education**

In column F, selected public expenditures on health and education were included as non-defensive contributions to welfare. If the accounting system for expenditures on health and education is to be consistent, adjustments to the personal consumption base are to be made: private defensive expenditures need to be subtracted. As in the case of public expenditures, only one half of the private expenditures on health and higher education should be included in the ISEW. Yet, to be consistent with the treatment of public expenditures, where data on expenditures on higher education was missing, I opted to use the same methodology as applied in column E: only half of the private expenditures on health and all education is included. Data on personal expenditures on health ('medical and social services') and education can be found on the CBS StatLine website.

## **Column G - Costs of Commuting**

Commuting costs result from modern patterns of urbanisation and settlements, as travelling is more and more needed to maintain the productive capacity of the economy. Yet these costs do not bring about an actual welfare improvement and should thus be considered defensive. As the costs of commuting are partly borne by consumers, private expenditures on commuting need to be subtracted from the consumption base of the ISEW. Data on private expenditures on transport (sum of expenditures on transport, cars and other transport-related costs) are provided by CBS for the period 1995-2004. The average ratio of the transport expenditures to the total private consumption expenditures is used to extend the time series. CBS StatLine also provides data on the underlying motives for displacements: The percentage of the average commuting distance to the total distance travelled each day increased from 21.38% in 1985 to 28.54% in 2004. Under the assumption that this percentage remained at the 1985-level in the period prior to 1985, the cost of commuting was calculated as being that part of the total private transportation costs that was made for commuting purposes.

## **Column H - Costs of Water Pollution**

Since no data on the costs of water pollution are available for the Netherlands, I have rescaled the US water pollution cost estimate of the original ISEW (Daly and Cobb, 1989) to fit the Netherlands, using 1972 GDPs of both countries as a benchmark. The cost estimate is then spread over the period 1971-2004 using the trend in the aggregated BBI index (Belgian Biotic Index) for Belgium (Bleys, 2006), as I was unable to find a water quality index for the Netherlands.

Some problems can be identified with using this valuation method. Firstly, rescaling the US estimate using GDP benchmarks requires the assumption that both the Dutch and the US economies have similar water pollution patterns (thus sharing technical factors and patterns of industrialisation), while geographical differences between both countries are also neglected. Secondly, using the Belgian BBI is very questionable, yet improvements in water quality were recorded in almost all EU countries. Thirdly, only data on surface water quality are used in calculating the aggregate index of biological water quality, yet water pollution also affects tidal rivers and - perhaps more importantly - groundwater supplies. The adoption of a quality index based on surface water quality assumes that these other waters more or less follow the same quality patterns. While it can be argued that this assumption holds for tidal rivers, the question of trends in groundwater pollution is considerably more complex (Jackson et al., 1997). There thus is ample room for improvement in estimating the country-specific costs of water pollution for the Netherlands.

## **Column I - Costs of Air Pollution**

The annual cost of air pollution to households, infrastructure and the environment is a typical example of an environmental cost that lies outside the boundary of traditional national accounts (Anielski and Rowe, 1999). Unfortunately, cost estimates to overcome this omission are scarce.

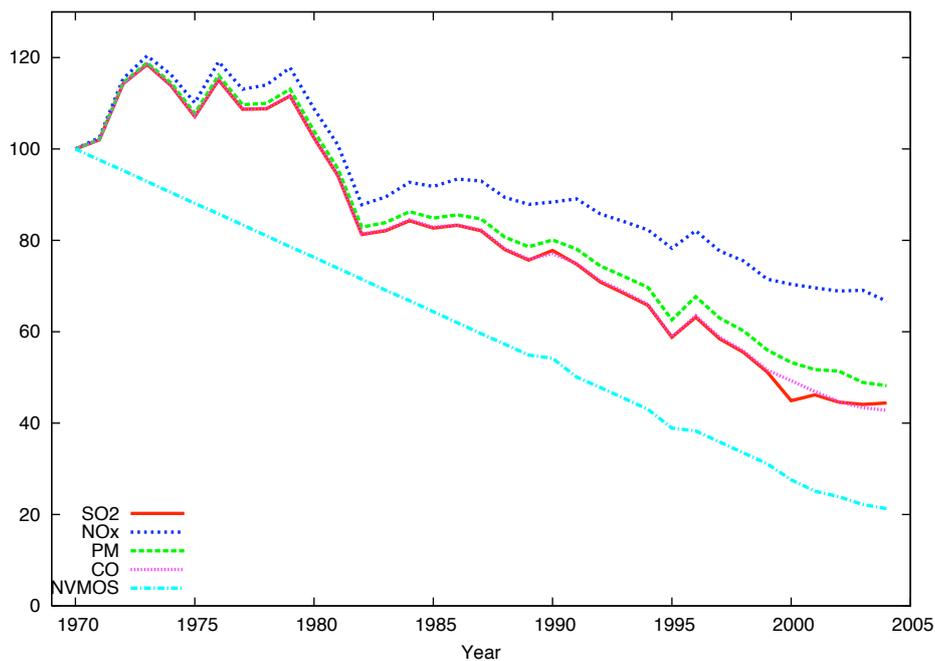


Figure 2: Trends in Emissions of Air Pollutants - 1970=100

Subsequent ISEW studies have put forward two methods to value the costs of air pollution. The US and Australian study start from a point estimate of air pollution costs in a specific year and spread this cost estimate over the time frame of their respective studies using either emission trends of certain pollutants, levels of ambient air quality or trends in fossil fuel consumption. Other studies (UK, Sweden) favour valuing air pollutant emissions by their respective marginal social costs.

Within the Dutch SISEW methodology, emissions of different types of air pollutants are valued using estimates of their marginal social costs. Although it would be better to work with levels of ambient air quality, limited data availability makes this option impossible. Following the English and Swedish ISEW studies, five air pollutants are considered within the air pollution item:  $SO_2$ ,  $NO_x$ ,  $PM$ ,  $CO$  and  $NVMOS$ .

Data on the emissions of these pollutants for the Netherlands are found on the CBS StatLine website. Since only these data do not go back to 1970 (data are given only for 1990, 1995 and 2000-2004), we need to expand the time series data for the other pollutants. As the emission rates of  $NO_x$ ,  $PM$  and  $CO$  are closely linked to the consumption of fossil fuels (Jackson et al., 1997), it is possible to work with the emission to fuel consumption ratios using time series analysis. Data on fossil fuel consumption are taken from UNEP's Geo Data Portal<sup>2</sup>. Linear regression is used to prolong the time series data on  $NVMOS$  emissions. The evolution through time of the different pollutant emissions is shown in figure 2, using 1970 as a benchmark (emissions in 1970 = 100).

<sup>2</sup><http://geodata.grid.unep.ch/>

Valuation of the emission of the different types of pollutants is based on their marginal social costs, which are taken from Jackson et al. (1997) and given in table 4. The authors use the average of two cost estimates, one based on a control cost method of monetarisation (Tellus) and the other on a review of literature on damage costs (Pace). For now, I also use the mean of both cost estimates, yet it should be noted that using the UK estimates will probably underestimate the actual costs for the Netherlands, as the Netherlands have a higher population density than the United Kingdom. According to Holland et al. (2005), differences in population densities is one of the main factors that help to explain differences in marginal social costs of air pollutant emissions.

Pollutant	Tellus (1991) 2000€/ton	Pace (1990) 2000€/ton	ISEW 2000€/ton
<i>SO<sub>2</sub></i>	1734.0	4688.5	3211.2
<i>NO<sub>x</sub></i>	7507.9	1892.9	4700.4
<i>PM</i>	4619.6	2755.9	3687.8
<i>CO</i>	1029.8		1029.8
<i>NVMOS</i>	6120.7		6120.7

Table 4: Marginal Social Cost Estimates of Different Air Pollutants

## Column J - Costs of Climate Change

Our collective behaviour imposes pressures on the environment (depletion of the ozone layer, global warming, nuclear waste, ...) and the impact of possible ecological catastrophes on future populations should no longer be neglected. However, both insights in these complex environmental processes and the cost estimates of their effects remain unagreed upon.

This column keeps track of the emissions of greenhouse gasses and the relating costs of climate change. Subsequent ISEW studies use either data on non-renewable energy consumption or on *CO<sub>2</sub>*-emissions as a starting point for their cost calculations. I have opted to work with the second one in the compilation of the Dutch SISEW.

After reviewing the little data available at the time, Daly and Cobb (1989) propose to levy a tax or rent on the amount of non-renewable energy that has been consumed since 1900 (cumulative consumption). They include nuclear fuels in this energy total claiming that “the social cost of leaving behind a mountain of spent fuel rods and reactors requiring decommissioning is perhaps as great as that imposed by climate change” (Cobb and Cobb, 1994). The tax is set to \$0.5 (1972\$) per barrel of oil equivalent of non-renewable fuels consumed and is applied to the cumulative consumption since 1990, reflecting the fact that most greenhouse gases have long atmospheric residence times and that they continue to contribute to environmental degradation long after their original emission. The amount of money generated by this tax can be thought of as “a fund available to compensate future generations for the long-term damage caused by the

use of fossil fuels and atomic energy” (Daly and Cobb, 1989). Daly and Cobb (1989) were the first to admit that the amount of the tax is largely arbitrary, but they defended themselves on the grounds that ignoring a major issue such as climate change because of the lack of a generally accepted methodology, would be wrong. The arbitrariness of the tax estimate has, however, attracted much criticism, resulting in the development of an alternative valuation method for the costs of climate change in more recent studies.

The second approach was first proposed by Jackson et al. (1997) in their ISEW study on the United Kingdom: “the basic idea is to assign to each tonne of emissions from 1900 onwards a ‘marginal social cost’ which reflects the total (discounted) value of all future damage arising from that tonne of emissions”. For each year, the costs of emissions are calculated by multiplying the carbon emissions in that year by the marginal social cost estimate for that year. The estimate of the total costs of climate change in a particular year is obtained after accumulating the costs from 1900 up to that year. Like most other marginal cost estimates of carbon emissions, the marginal social cost estimate used by Jackson et al. (1997) varies over time to be consistent with the fact that the damage is dependent on the stock of carbon in the atmosphere and on the rate of economic growth (Clarkson and Deyes, 2002). In the UK ISEW, a cost estimate of £11.4 (in 1990£) per tonne of carbon emitted, is used for 1990, based on Fankhauser (1994). Next, Jackson et al. (1997) assume that the marginal social cost in any year is proportional to the cumulative carbon emissions from the year 1900 up to that year. As the 1990 marginal social cost estimate of carbon emissions used in the UK ISEW study is located towards the lower end of a range of possible estimates at the time of the publication of their report, Jackson et al. (1997) regard their costs of climate change estimates as relatively conservative. I favor the use of this method, as it is less arbitrary and allows for a more meaningful sensitivity analysis. Different cost estimates for carbon emissions can be used in order to investigate the impact of their underlying models on the evolution in time of per capita ISEW. Downing and Watkiss (2004) review the different marginal social costs of carbon that are used in policy making.

Historical data on the emissions of  $CO_2$  for the Netherlands are taken from CBS StatLine (total emissions for 1990, 1995, 2000-2004) and UNEP Geo Data Portal (emissions from fossil fuels for the period 1960-2003). The ratio between the latter and the former for the years in which data exists for both is taken to calculate  $CO_2$  emissions for 1971-2004. I have tried to follow the methodology described in Jackson et al. (1997) as closely as possible. The marginal social cost estimate for 1990 from their study is transformed into a value of €20.41/tC (2000€) using the appropriate exchange rate and GDP deflator. The marginal social costs estimates for all other years are estimated by linking this 1990 estimate to the cumulative  $CO_2$  emissions since 1900<sup>3</sup>.

Some critics of the ISEW have argued that only the annual contributions to future damages from climate change should be counted in each year, as is done in the Genuine Savings index (Hamilton and Atkinson, 1996). Here, the future damages from carbon emissions are treated

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<sup>3</sup>It is assumed that 4 billion tons of  $CO_2$  were emitted prior to 1960 (based on historical data for Belgium)

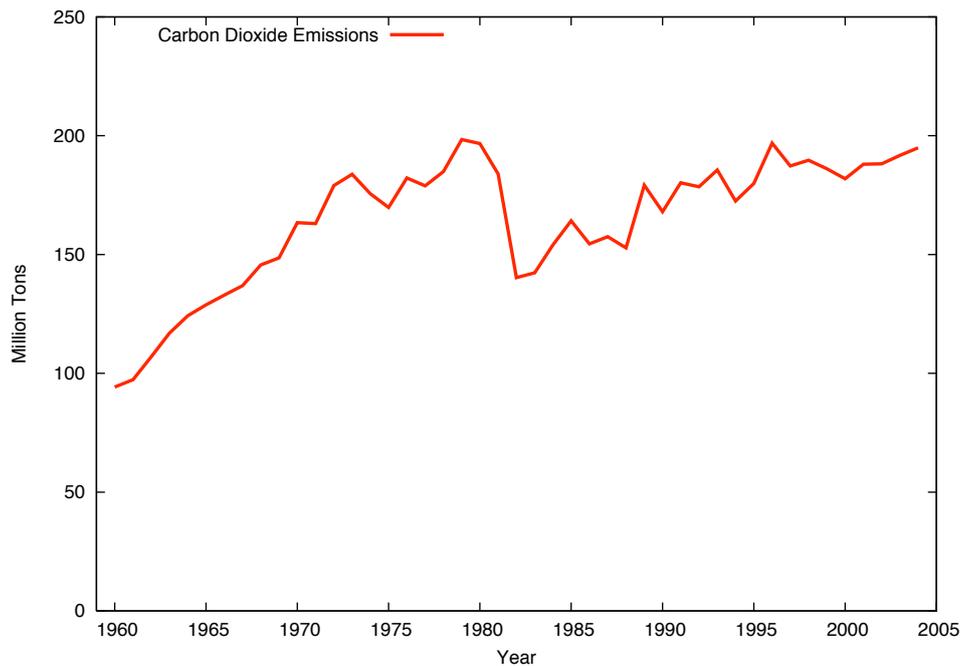


Figure 3: Carbon Dioxide Emissions since 1960

on exactly the same basis as, for example, the annual damages from sulphur dioxide. As Jackson et al. (1997) note, there are some fundamental differences between these two kinds of emissions and their associated damage costs. While the damage costs associated with emissions of sulphur dioxide represent present-day social costs, damage costs associated with carbon emissions are essentially the discounted value of welfare losses suffered by future generations. Accounting for these different kinds of welfare losses in a 'correct' way will depend upon the interpretation given to the ISEW. As a measure of sustainable economic income should reflect the present discounted value of future welfare, the present value of future welfare losses is the very least that such a measure should measure (Jackson et al., 1997). From this point of view, paying off the long-term damages associated with activities from a single accounting period would not reduce the present value of future welfare losses to zero, as the accumulated debt of the past would still represent a real loss in the future.

### Column K - Costs of Ozone Layer Depletion

After Eisner pointed out that not all long-term environmental damage is related to energy consumption, Cobb and Cobb (1994) incorporated the costs of ozone layer depletion in the ISEW methodology during their 1994 revision of the index. Cobb and Cobb were particularly concerned that they had omitted a damage estimate from the cumulative release of chlorofluorocarbons into the upper atmosphere, since these emissions are responsible for the decrease of the thickness of the ozone layer (e.g. the ozone hole above Antarctica). As a result, a new column, which estimates the costs of ozone depletion by applying a unit cost of \$5 (in 1972\$) for each kilogramme of cumulative world production of both CFC-11 and CFC-12, was introduced in the updated ISEW methodology. As, at that time, one-third of the world production of ozone-

depleting substances took place within the United States, the cost estimate was equivalent to a cost of \$15 (1972\$) to each kilogramme of US production. The cumulative CFC production was taken as a starting point, since both substances have long atmospheric residence times.

Two adjustments to this methodology were made in more recent ISEW studies. Firstly, Jackson et al. (1997) extended the list of harmful ozone depleting substances to include all Montreal<sup>4</sup>-listed CFCs: CFC-11, CFC-12, CFC-113, CFC-114 and CFC-115. The estimated unit cost per kilogramme of CFCs emitted was rescaled by weighting the Cobb and Cobb cost by the ratio of the cumulative consumption of CFC-11 and CFC-12 to the cumulative consumption of all the listed CFCs. This procedure resulted in a unit cost estimate of about £30 (1990£). Secondly, the Swedish ISEW study (Jackson and Stymne, 1996) used CFC-consumption figures rather than production figures, as no actual CFC-production took place in Sweden. The authors argue that “[although] some countries produce no CFCs at all, by consuming them they are clearly contributing to future environmental damage, for which they are in some sense accountable”.

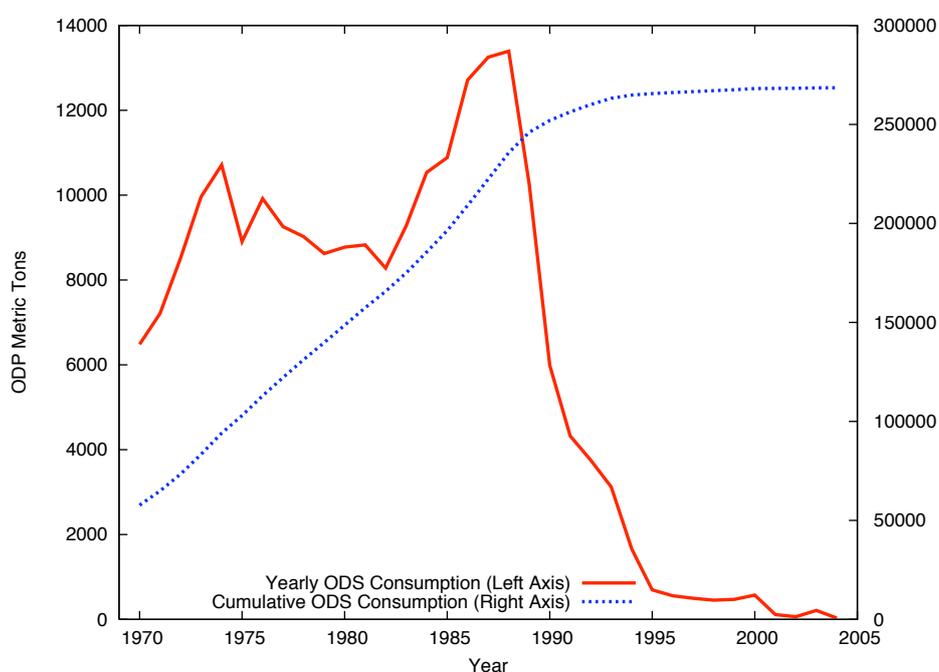


Figure 4: Yearly and Cumulative Consumption of Ozone Depleting Substances

Both arguments are taken in within the Dutch SISEW: costs are estimated using cumulative consumption figures of all Montreal-listed CFCs. An estimate of the per capita CFC-consumption figure for the European Union was made using data on ozone depleting substances (ODS) production from the AFEAS-website<sup>5</sup> and information on CFC-consumption for the European Union (UNEP, 1999) and for Europe as a whole (Geo Data Portal). Since no data on CFC-consumption in the Netherlands are available, I have opted to multiply this per capita

<sup>4</sup>The Montreal Protocol came into force in 1987 to gradually phase out the production of ozone depleting substances (ODS)

<sup>5</sup>[http://www.afeas.org/prodsales\\_download.html](http://www.afeas.org/prodsales_download.html)

CFC-consumption figure for the European Union by the total population of the Netherlands (CBS StatLine) in order to arrive at a cumulative CFC-consumption figure for the Netherlands. Conversion of the cost estimate used in Jackson et al. (1997) has led to a unit cost of €53 (2000€) per kilogramme of CFC-equivalent. Each year, this unit cost is applied to the cumulative CFC consumption in the Netherlands. The impact of the Montreal Protocol can clearly be seen in figure 4, which depicts both yearly and cumulative consumption of ozone depleting substances (CFCs) in the Netherlands.

## **Column L - Depletion of Non-Renewable Natural Resources**

Depletion of non-renewable natural resources represents a loss of natural capital and thus a reduction of future consumption possibilities. It is clear that this depletion impoverishes future generations, however no account of the future losses is made in the national accounts. Daly and Cobb (1989) looked into a number of possible solutions to overcome this problem and concluded that El Serafy's model for relating 'true income' to total receipts from mineral production via a discount rate and the number of years to depletion was, at the time, the best attempt. However, due to the practical limitations of his model, Daly and Cobb decided to take the total value of receipts from mineral production in order to account properly for natural capital depletion.

Yet, as this method attracted much criticism during the 1994 review of the index, a different valuation method was introduced. Cobb and Cobb (1994) estimate the amount of money that has to be put aside in order to compensate future generations for the loss of natural capital. Consumption of primary fuels (coal, oil, gas, nuclear) is valued using a replacement cost factor which reflects the costs involved in replacing each barrel of oil equivalent of energy consumed with renewable energy resources. The replacement cost was taken to be \$75 in 1988 (or around €84 in 1995€) and is assumed to be subject to a 3% per year increase to account for the increasing costs of supplying each marginal unit of energy. Current market prices of alternative energy sources are lower than the replacement costs used in the ISEW studies, but Cobb and Cobb (1994) put forward some arguments for using their cost estimates and assumed escalation:

- the tendency of supplies to become increasingly expensive at the margin
- the relatively low energy ratio of some renewable energy technologies (energy output to energy input)
- and the potential influences of future land prices on biomass resources (as the authors consider this particular option as the most promising one)

Most other ISEW and GPI studies copy this valuation method, although it must be noted that the Australian one (Hamilton and Denniss, 2000) omits coal consumption, as the authors claim that today's known economic reserves of coal are enormous.

I have used the same methodology in the calculation of the Dutch SISEW, working with the replacement cost estimates proposed in the US study. The total amount of non-renewable

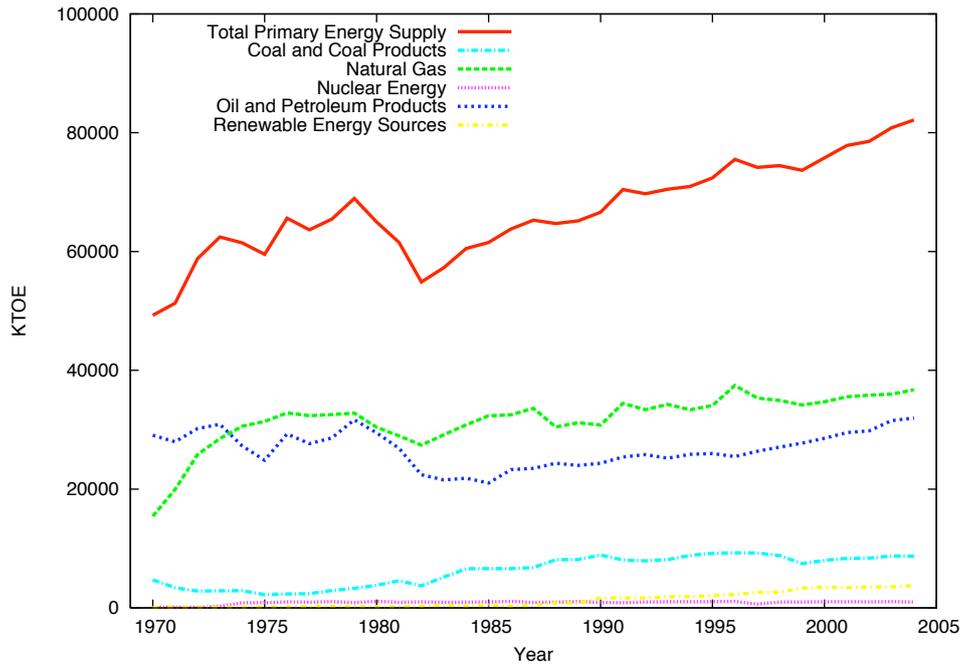


Figure 5: Total Primary Energy Supply and Composition

energy (including coal) produced each year in the Netherlands is taken from UNEP's Geo Data Portal (after conversion to BOE-units) and can be found in figure 5.

### Column M - Net Capital Growth

Because of the complementarity of human-made and natural capital, sustainable economic welfare requires both types of capital to be non-declining. In terms of human-made capital, this implies that the quantity of capital goods per worker should not decline. Therefore, should the additions to the stock of human-made capital goods be greater than the necessary minimum requirement, called the 'growth requirement' (Daly and Cobb, 1989), the difference constitutes an increase in a nation's productive capacity, which constitutes a clear benefit (Lawn, 2003). However, within the theoretical background of the ISEW, this item remains hard to validate using the income and capital concepts of Fisher.

Where Daly and Cobb (1989) include all human-made capital (private and public) in this item, Cobb and Cobb (1994) exclude government capital from the calculations following criticism by Carson and Young, as the inclusion of this type of capital is inconsistent with the exclusion of the services rendered by public capital elsewhere in the index. Net capital growth is calculated as follows :

$$NetCapitalGrowth_t = C_t - D_t \quad (3.2)$$

$$D_t = B_{t-1} \times A_t \quad (3.3)$$

where A is the 5-year rolling average of the change in number of people employed, B is the 5-year rolling average of the net capital stock (private capital only), C is the change in this

rolling average B and D is the ‘capital requirement’ (the capital growth necessary to maintain a constant level of capital per worker), while  $t$  denotes the year.

In calculating the net capital growth, I have tried to follow the methodology outlined by Cobb and Cobb (1994) as closely as possible. Data on the number of people employed are obtained from the CBS StatLine website, while data on the net capital stock for the Netherlands were directly provided by the Centraal Bureau voor Statistiek (CBS). Unfortunately, these data make no distinction between private and public capital, so both types of human-made capital are included in the Dutch SISEW. The net capital growth for 1970 cannot be calculated, as no data on the capital stock are available for 1969. Figure 6 shows the evolution in time of both net capital growth and labour force for the Netherlands (1971-2004).

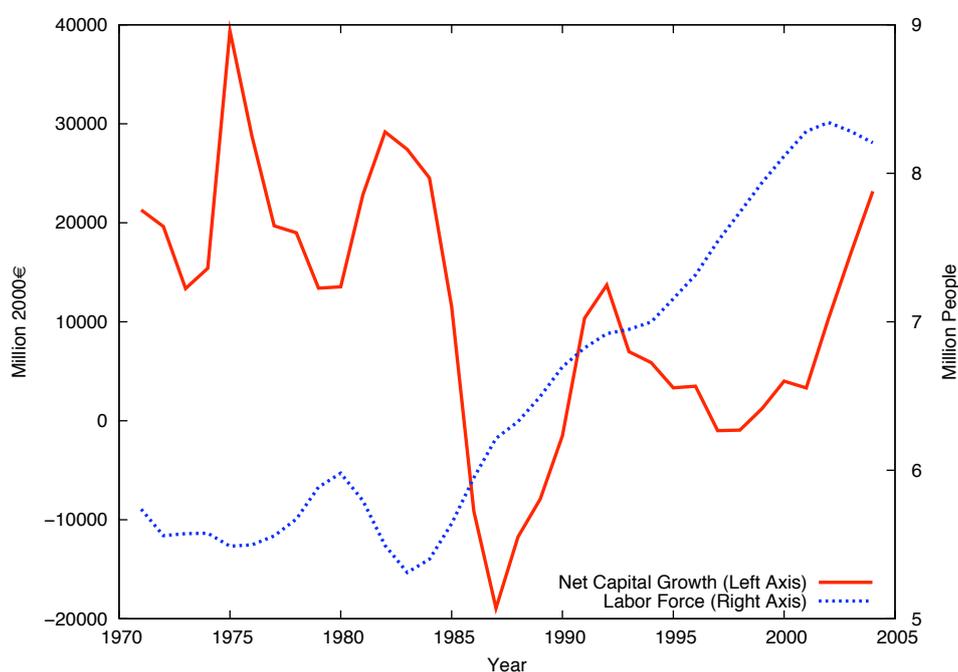


Figure 6: Net Capital Growth and Labor Force

## Column N - Change in Net International Investment Position

As Daly and Cobb (1989) claim that “sustainability requires long-term self-reliance”, they include in their methodology a measure of changes in the net international investment position to account for the degree of a country’s self-reliance. Any tendency towards net borrowing is regarded as unsustainable consumption, since the borrowed welfare must eventually be paid back (Jackson and Stymne, 1996).

Data on the net international investment position (NIIP) of the Netherlands are taken from various International Financial Statistics Yearbooks from the International Monetary Fund (IMF), yet they only go back to 1983. Where possible, a 5-year rolling average of the changes in the NIIP is added to the ISEW base, while for the period 1983-1986 shorter time frames were

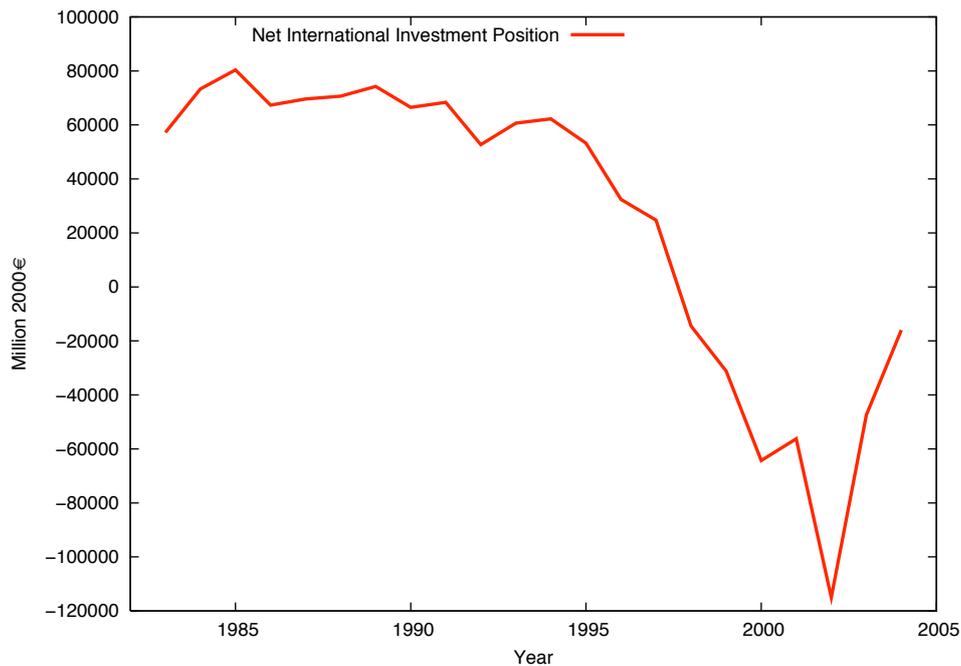


Figure 7: The Net International Investment Position for the Netherlands

used. Since the NIIP values are relatively low in the early 1980s (especially when compared with data from the 1990s - see figure 7) and as the international transfers at that time were low, I have opted to work around the data inavailability by ignoring this column in the 1970s. In my opinion, the errors involved in making this assumption will not have a large effect on the ISEW totals, although there is certainly room for improvement here.

### **Column O - Simplified Index of Sustainable Economic Welfare 1 (SISEW1)**

The Simplified Index of Sustainable Economic Welfare (SISEW1) is calculated by adding columns D, E, M and N to column B, while subtracting columns C to L. The index is expressed in constant 2000€.

### **Column P - Per Capita SISEW1**

Per capita ISEW has been calculated by division of column O (SISEW1) by column W (population).

### **Column Q - Simplified Index of Sustainable Economic Welfare 2 (SISEW2)**

The Simplified Index of Sustainable Economic Welfare (SISEW2) is calculated by adding columns D, E, M and N to column B, while subtracting columns C, D, E, G, I, J, K and L. The index is expressed in constant 2000€.

### **Column R - Per Capita SISEW2**

Per capita ISEW has been calculated by division of column Q (SISEW2) by column W (population).

### **Column S - Simplified Index of Sustainable Economic Welfare 3 (SISEW3)**

The Simplified Index of Sustainable Economic Welfare (SISEW3) is calculated by adding columns D, E, and M to column B, while subtracting columns C, D, E, I, J, K and L. The index is expressed in constant 2000€.

### **Column T - Per Capita SISEW3**

Per capita ISEW has been calculated by division of column S (SISEW3) by column W (population).

### **Column U - Gross Domestic Product**

The CBS StatLine website provides figures on the Gross Domestic Product (GDP) for the Netherlands, both in current and in constant prices. GDP data in constant 2000€ are given in column U.

### **Column V - Per Capita GDP**

Per capita ISEW has been calculated by division of column U (GDP) by column W (population).

### **Column W - Population**

Population data on the Netherlands are found on the CBS StatLine website. During the period of our study (1970-2000), the Dutch population increased by a total of 3.3 million people.

## **4 Preliminary Results**

The results of the Dutch SISEW analysis are shown in figure 8, where per capita GDP is plotted against per capita ISEW. Three versions of the SISEW are presented, each one with a different set of selected items (as explained in section 2). SISEW1 is comprised of all 13 items presented above, while SISEW3 is made up of only 9 items (defensive private expenditures on health and education, costs of commuting, costs of water pollution and changes in the net international investment position are dropped).

A number of interesting conclusions can be drawn from this graph. First, we notice that, for all three versions of the Simplified Index of Sustainable Economic Welfare, the 2004 level of economic welfare per capita is almost the same as the 1971 level and this while GDP/capita shows an almost continuous increase over the same period. Next, looking at the trend over

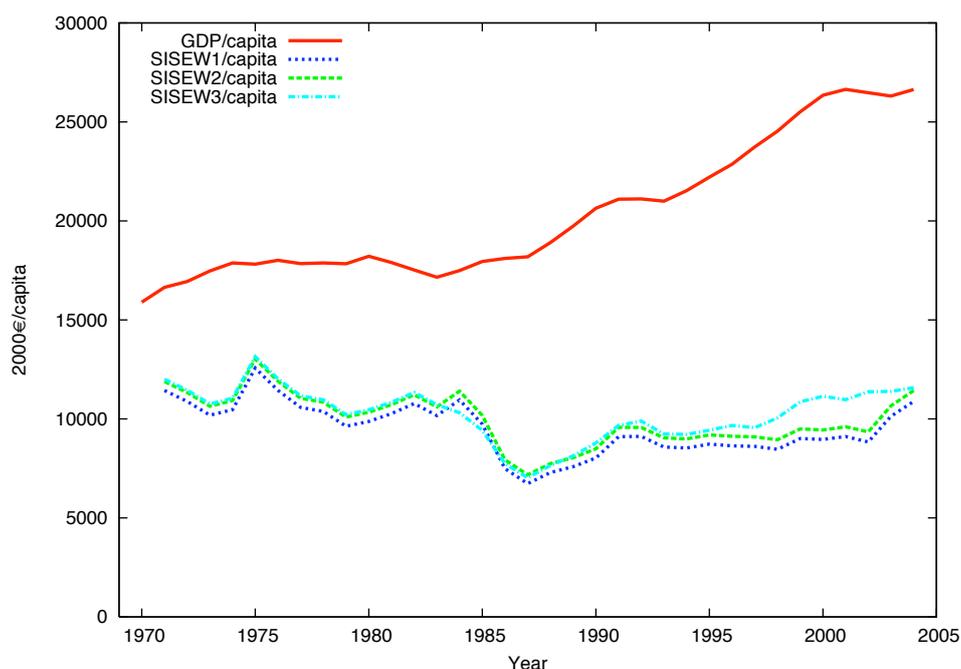


Figure 8: The Simplified Index of Sustainable Economic Welfare for the Netherlands

time of the different SISEWs, it is possible to split the period analyzed into two shorter ones: a period of decline in economic welfare up to 1987 when SISEW/capita reaches its period low, and one of rising economic welfare levels afterwards. A third and more obvious conclusion is that all three SISEW versions show more or less the same trend over time (with the one exception being SISEW3 in the period 1995-2000, when the Netherlands witnessed a dramatic decrease in its net international investment position).

	SISEW1	SISEW2	SISEW3	GDP		SISEW1	SISEW2	SISEW3	GDP
1971	100.0	100.0	100.0	100.0					
1975	95.2	95.3	95.4	101.8	1971-1975	-1.2	-1.2	-1.2	0.4
1980	86.3	87.0	87.2	109.4	1975-1980	-1.9	-1.8	-1.8	1.5
1985	85.1	85.6	78.5	107.9	1980-1985	-0.3	-0.3	-2.1	-0.3
1990	70.2	71.4	73.2	124.0	1985-1990	-3.8	-3.6	-1.4	2.8
1995	76.3	77.3	78.6	133.5	1990-1995	1.7	1.6	1.4	1.5
2000	78.4	79.4	92.9	158.3	1995-2000	0.5	0.5	3.4	3.5
2004	95.2	96.2	96.5	160.1	2000-2004	5.0	4.9	1.0	0.3

Table 5: Trends in (left) and Average Annual Growth Rates of (right) per capita Indexes

These findings are confirmed in table 5, that presents both the evolution of all indexes to their relative 1971 figures and the average annual growth rates of 5-year intervals. All SISEW indexes fall steadily throughout the 1970s and 1980s, before bouncing back in the 1990s and the early 2000s. Note that the differences in annual average growth rates between SISEW1 and SISEW2 on the one hand and SISEW3 on the other are fully attributable to the 'changes in net international investment position' item that is excluded in the latter. Looking at GDP/capita, we find a different pattern: although average annual growth rates vary over the different periods

under consideration, GDP/capita shows an almost continuous increase. In fact, only in the period 1980-1985, the Dutch GDP/capita fell.

The preliminary findings of this SISEW study for the Netherlands are not in line with Max-Neef's 'threshold hypothesis', which states that, for every developed country, economic growth will contribute to economic welfare only up to a certain point - the threshold point - after which further economic growth will have a negative impact on economic welfare.

From these figures it can be concluded that increases in production and consumption have not always led to increases in economic welfare (as measured by the ISEW). Since the growth rates of both indicators differ substantially, measures of economic income, such as the Gross Domestic Product, cannot be used as accurate proxies for economic welfare.

It would be interesting to analyse the evolution of the different items that constitute the ISEW. I have organised the individual items described in this chapter into the different categories that appear in the general outline of the ISEW methodology. Figures 9 en 10 plot the evolution in time of both the positive and the negative items in the ISEW as percentages of the respectively positive and negative totals.

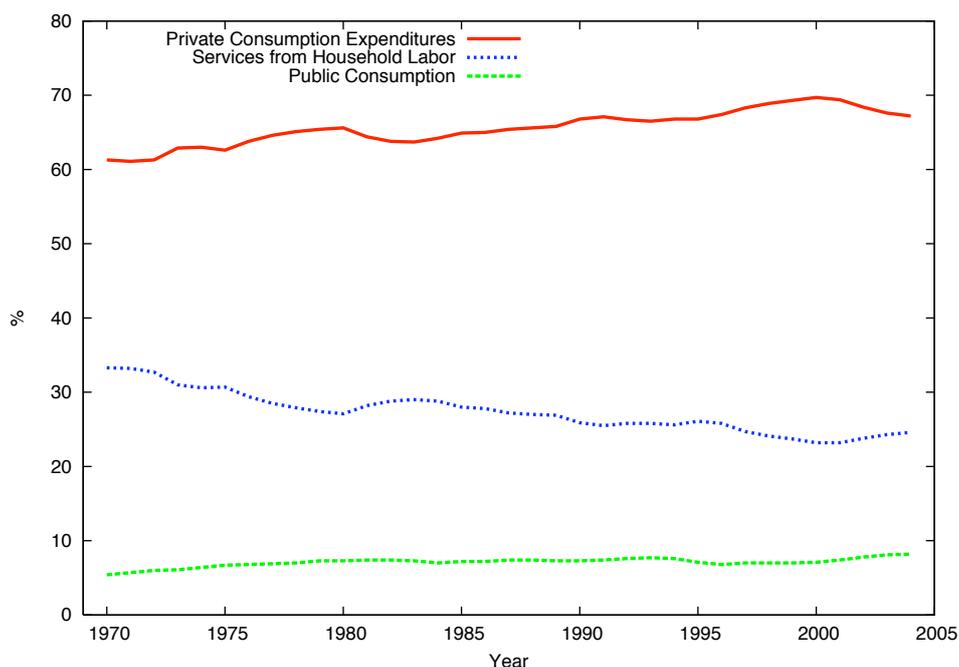


Figure 9: Positive Items in ISEW Methodology - % of Total

'Private consumption expenditures' is by far the most important positive item within the ISEW framework. Among the most important negative ones, we find depletion of natural capital, long-term effects of environmental pollution and losses from income inequality. Four items stand out from this analysis. First, on the positive side, public expenditures on health and education lose ground when compared to the other positive items. Next, we notice a decline in the costs of the direct effects of environmental pollution, which can be almost fully attributed to a decline in the

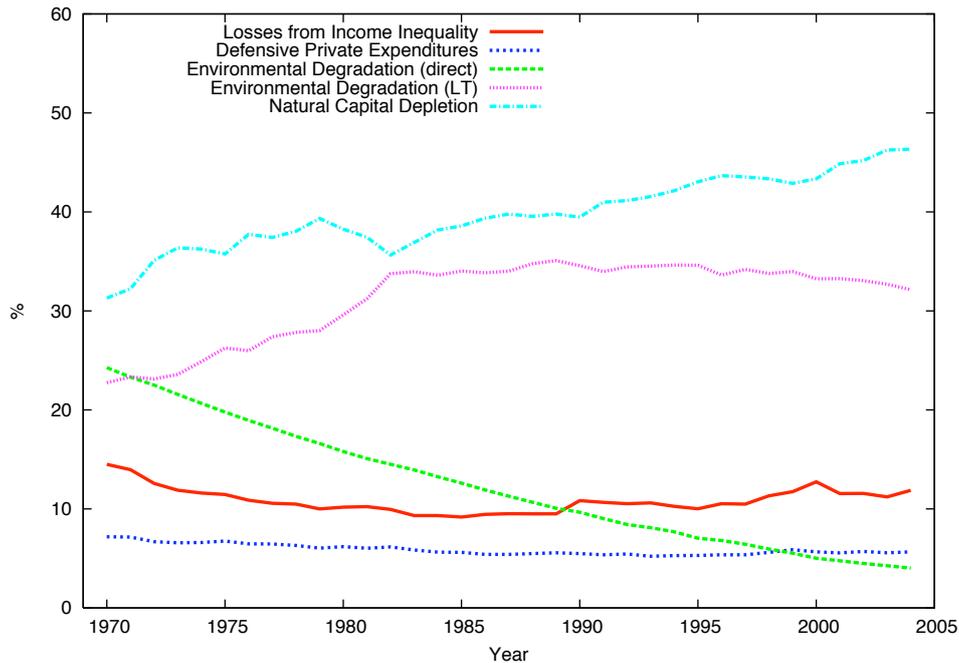


Figure 10: Negative Items in ISEW Methodology - % of Total

costs of air pollution (see also figure 2). A third category of interest is long-term environmental degradation: a sharp increase in relative importance in the 1970s comes to an abrupt end in the 1980s, mainly as a result of a decrease in non-renewable energy consumption as a result of the second oil crisis and, later, a decrease in the consumption of CFCs. Finally, the costs of natural capital depletion have gained importance, since the amount of non-renewable energy consumed has risen. Part of this increase can be explained by the valuation method employed in the ISEW methodology, as a scarcity factor is added to the replacement cost estimate used in the valuation. However, this scarcity factor has attracted criticism, as it inflates the total of the negative items in the ISEW (Neumayer, 2000). The last three findings discussed here can be found in figure 10.

Table 6 looks at the different individual items in the ISEW methodology, analysing their evolutions over the different decades (for each item, the 1971 value is set to equal to 100). The items are divided into two categories (positive and negative items), as was done in the previous section. The last column of the table ('2004%') is calculated for each item as the percentage of its 2004 value to the total 2004 value of the positive or negative totals, to give the reader an idea of the relative importance of the different items.

From table 6 we can draw several conclusions. First, we can conclude that, over the period of the study, the SISEW had a lower (relative) growth rate than the GDP. Next, it is clear that both positive and negative items in the ISEW framework have grown over the years (in total). However, these general findings are not reflected in all individual items:

- two 'negative' items have experienced negative growth rates throughout the period of the study (costs of water pollution and costs of air pollution)

	1971	1980	1990	2000	2004	2004%
<i>Positive Items</i>	100	111.6	123.1	162.5	169.1	100
Personal Consumption Expenditures	100	119.8	134.7	185.4	186.1	67.2
Value of Household Work	100	91.1	95.8	113.6	125.0	24.6
Public Expenditures	100	142.7	158.3	202.7	243.2	8.2
Net Capital Growth		data not considered in this analysis				
Change in Net International Position		data not considered in this analysis				
<i>Negative Items</i>	100	138.6	181.1	246.5	281.5	100
Losses from Income Inequality	100	101.0	140.5	224.9	239.4	11.9
Defensive Private Expenditures	100	119.8	134.7	169.9	213.5	3.7
Costs of Commuting	100	119.8	146.3	247.6	240.8	2.0
Costs of Water Pollution	100	99.5	94.5	83.5	80.3	1.3
Costs of Air Pollution	100	92.5	70.3	45.6	40.6	2.7
Depletion of Non-Renewable Resources	100	164.5	221.6	331.4	404.5	46.3
Costs of Climate Change	100	159.6	231.7	332.5	379.9	24.2
Costs of Ozone Depletion	100	229.0	388.3	413.1	413.8	8.0
<i>SISEW1</i>	100	92.7	79.9	94.8	118.0	
<i>SISEW2</i>	100	93.4	81.1	96.0	119.2	
<i>SISEW3</i>	100	93.6	83.1	112.3	119.6	
<i>GDP</i>	100	117.5	140.8	191.4	198.3	

Table 6: Annual Growth Rates of Individual Items - 1971=100

- one 'positive' item grew faster (personal consumption expenditures) and two grew slower (value of household work and public expenditures on health and education) than the general trend
- some 'negative' items grew faster (e.g. costs related to long-term environmental damage and depletion of non-renewable natural resources) and some grew slower (e.g. defensive expenditures) than the general trend

## 5 Revised Methodology

The Index of Sustainable Economic Welfare has attracted much criticism over the years, both on its theoretical foundation (or the lack of one) and on its methodology. I have developed an adjusted methodology for the ISEW to accommodate for these concerns and applied it to the ISEW for Belgium. The results of this exercise can be found in (Bleys, 2007). In this section, I have recalculated the SISEW for the Netherlands using the methodological adjustments proposed in this paper. But first I will explore the theoretical framework of the ISEW, the criticism on its methodology and the proposed adjustments.

### 5.1 Theoretical Background of the Index

Lawn (2003) worked out a sound theoretical framework for the ISEW based on the income concept of Fisher. Within this concept, income is regarded not as the amount of goods and services produced or consumed in a particular year, but as the services derived from all consumer goods by final users ('psychic income'). This concept of psychic income can easily be extended to include 'psychic outgo', as a reflection of the irksome activities of the economic

progress (environmental pollution, commuting, ...). Working with the Fisherian income concept also forces one to recognize that the continual maintenance of the human-made capital stock should be seen as a cost and not as a benefit: services provided by natural capital are lost in obtaining the necessary throughput required to keep the stock of human-made capital intact (Lawn, 2003). As a result, the costs of lost source, sink and life-supporting services provided by natural capital are deducted. More recently, Lawn (2006) placed the concept of 'net psychic income' into a larger linear throughput model of the socio-economic process based on a coevolutionary worldview.

There is, however, one weakness in the ISEW framework: although the costs of environmental damage and natural capital depletion are included in the index, it does not provide a means to measure the sustainability of the economic welfare. In order to overcome this flaw, Lawn (2003) proposes the use of supplemental natural capital accounts.

## 5.2 Critical Analysis

The criticism that the ISEW has attracted over the years can be divided into two categories: methodological issues on the one hand and practical issues on the other. Methodological issues shed doubt on the value of the entire exercise, while practical issues are concerned with (the valuation of) specific items within the methodology of the ISEW or with data quality or availability.

On the methodological level, Neumayer (1999) argues that the authors of the ISEW commit the mistake of methodological inconsistency in two respects:

- the ISEW cannot at the same time function as both an indicator of current welfare and an indicator of sustainability: what affects current well-being need not affect sustainability and vice versa
- the index is not an indicator of strong sustainability, but one of weak sustainability, since the ISEW framework allows for perfect substitution among different types of capital

Another methodological 'flaw' of the ISEW that is emphasized is the high amount of subjectivity that enters its methodology. The researcher has to decide which items he will incorporate in the methodology of the index and which valuation methods he will employ. When the choices and assumptions made by the researcher during the compilation of the index are not clearly communicated, the risk of misinterpretation of the results is high. It is therefore essential that researchers working on the Index of Sustainable Economic Welfare make explicit all assumptions that enter the methodology of the index and that they underline that the value of the whole exercise lies in its rationale (economic growth and economic welfare are not necessarily the same) and not so much in its empirical results.

On a more practical level, several valuation methods within the ISEW methodology have been criticized over the years. Concerns that minor adjustments to these valuation methods would have a significant impact on the index and the conclusions drawn from the ISEW studies, were

expressed by many authors. The two components that have attracted the largest amount of criticism are non-renewable resource depletion and long-term environmental damage. Neumayer (1999) claims that adjusting the assumptions made in the valuation methods of these items would remove the marked divergence between non-renewable resource depletion costs and GDP growth on the one hand, and between the costs of climate change and GDP growth on the other. Based on these insights, Neumayer (2000) argues that the threshold hypothesis, as defined by Max-Neef, fails to materialize and that the growing gap between per capita ISEW and per capita GDP “might be an artifact of highly contestable methodological assumptions”.

### **5.3 Proposed Changes to the Methodology**

The methodology of the ISEW has not changed much since the introduction of the index in 1989. Although a structural rethinking of the index is needed to deal with the criticism outlined above and with some of the outdated valuation methods within the ISEW framework, the focus in recent years has been on the compilation of the index in more countries and on a rebranding of the index in order to gain a broader acceptance among policymakers.

However, as the ISEW is far from a perfect measure of economic welfare, adjustments to the methodology of the index are necessary to increase its value as a valid indicator of welfare. The development of a theoretical framework for the index (Lawn, 2003) was a huge step forward. Working with the Fisherian income concept forces one to distinguish between the actual capital stocks and the flows of services that these capital stocks deliver. The latter are important to measure the level of welfare or income currently enjoyed by a nation’s citizens, while the former indicate whether this level can be sustained in the future.

People enjoy services from direct consumption (goods and services consumed immediately at the time of purchase), from consumer durables, from the publicly provided human-made capital stock and from the stock of natural capital. Where the ISEW captures the first three types of services positively, services derived from the stock of natural capital are accounted for negatively. This is because it is often easier to value the natural capital services that are lost in the economic process, rather than trying to value the total amount of services provided by natural capital (which would be declining).

Capital stocks give an indication about the sustainability of the level of welfare enjoyed at a given moment in time. As Lawn (2003) rightly argues, the ISEW does not directly provide information about the ecological sustainability of the level of welfare enjoyed in a country. The index needs to be supplemented with a natural capital account in order to do so. Other supplemental accounts could trace the sustainability of the economic process in terms of the stock human-made capital and the level of national self-reliance (financial, food production, natural resources). The Genuine Savings index can be used here in order to capture how sustainable the eventual welfare gains are in terms of natural capital depletion.

The ISEW goes far in being consistent with the Fisherian income and capital concept, yet a few problems remain. First, two items within the methodology of the ISEW should be omitted

as they are hard to comply with the theoretical foundation of the index: the 'net capital growth' item and the 'changes in the net international investment position' item. Next, some valuation methods need to be updated. This paper looks more specifically at the valuation of natural capital depletion, long term environmental damage and ozone layer depletion and the treatment of public expenditures.

### **5.3.1 Omissions**

The 'net capital growth' item is added to the consumption base of the index as capital growth that exceeds the growth requirement adds to a nation's productive capacity. Where changes in the stock of natural capital are not considered within the index, changes in the stock of human-made capital are included. This perverse methodological difference in the treatment of different capital stocks should be abandoned and both stocks should be monitored outside the ISEW (as is now done for the stock of natural capital). Here, any assumption regarding the level of substitutability between both types of capital can be adopted (weak or strong sustainability concepts). Lawn (2003) already alluded to the controversy of including the 'net capital growth' item in the ISEW, as he rightly argues that within the Fisherian concept of income and capital, additions to the stock of human-made capital should not be counted as income.

Changes in the net international investment position (NIIP) should also be dropped from the index. If we wish to investigate the long-term financial self-reliance of a country, we should look at the actual NIIP itself, and not at the annual changes in this stock. Using these changes in the NIIP could be misleading, as for countries with a decreasing but positive NIIP the index is adjusted downwards, while these countries have no foreign debt at all. Next, for small countries with a relatively open economy, such as Belgium and the Netherlands, the NIIP item as currently employed has a significant and even overwhelming impact on the overall evolution of the index. Therefore, I would suggest to omit the NIIP item from the ISEW and use the eventual foreign debt of a country as a third supplemental account - besides human-made and natural capital stock accounts - by which the sustainability of a country's level of welfare can be analyzed. This account can also include information on the dependency of a nation on other nations for its food supplies and supplies of natural resources needed for the economic process, as these dependencies are also valuable inputs for policymakers.

### **5.3.2 Revised Valuation Methods**

Three valuation methods within the methodology of the Index of Sustainable Economic Welfare are updated in order to more closely match the estimated costs of environmental problems with their actual impacts and, as such, to deal with some of the critical remarks outlined above.

#### **Natural Capital Depletion**

In the ISEW, the amount of rent from resource production that should be reinvested in a process to create a perpetual stream of renewable substitutes for the non-renewable resources that are being the depleted, is estimated in order to factor in natural capital depletion. Cobb and Cobb

(1994) employ an arbitrary value of \$75 for 1988 per barrel of oil equivalent (BOE) and assume that this replacement cost factor increases at an estimated annual growth rate of 3% to reflect both increases in future demand and rising energy costs (which constitute a large part of the production of renewable alternatives).

However, non-renewable energy consumption in the Netherlands has increased only at a rate of 1.37% a year over the last thirty years and the cost escalation factor is in conflict with any understanding of learning curves and scale effects (actual prices of available alternatives are falling). Furthermore, Neumayer (2000) dislikes the fact that, within the ISEW methodology all non-renewable natural resources have to be substituted straightaway and this while there are still plenty reserves available.

In defense of the current valuation method for natural capital depletion, Lawn (2005) argues that, while it may not be necessary to think about renewable substitutes for some time, the actual cost of establishing a renewable replacement must be attributed to the point in time when the depletion took place. I follow Lawn in this regard, yet object to the further use of the 3% per annum escalation factor. Consequently, this factor has been omitted from the updated ISEW methodology.

### **Long-Term Environmental Damage**

Neumayer (2000) disagrees with the accumulation of the cost of long-term environmental damage caused by climate change, which is done in all ISEW studies except in one. He argues that this accumulation leads to multiple counting, as valuing a tonne of greenhouse gas emissions by its marginal social cost in a given year already includes the future costs of this emission in terms of its discounted value over all time. This idea can easily be extended to emissions of ozone depleting substances. Lawn (2005) on the other hand defends the accumulation by pointing out that, as the ISEW measures the sustainable economic welfare of a nation at the time it is experienced, past emissions of greenhouse gases and ozone depleting substances will have a substantial impact on this experience. Hence, the total cost in any given year should reflect the amount required to compensate a nation's citizens in that year for the cumulative impact of long-term environmental damage of past as well as present economic activities.

Although I tend to agree with Lawn (2005) on taking into account both past and present emissions when valuing long-term environmental damages, things seem to be a little more complicated than that. Climate change and ozone depletion are problems caused by a stock of pollutants in the atmosphere, while the ISEW uses cumulative emission flows to value the costs associated with these environmental issues. By endlessly accumulating the emissions of greenhouse gases and ozone depleting substances, the ISEW does not take into account the atmospheric lifetimes of these pollutants and assumes that the costs of the related environmental problems are non-decreasing. Yet, in the case of ozone depletion, the measures taken following the Montreal Protocol in 1987 have effectively reduced emissions of ozone depleting substances to almost zero. The consequences of this drop in global emissions are becoming more and more apparent: according to UNEP's 'Synthesis of the 2002 Assessments of the

Type	Share	Atmospheric Lifetime (WMO, 1994)
<i>CFC</i> – 11	0.35	50 years
<i>CFC</i> – 12	0.55	100 years
<i>CFC</i> – 113	0.10	85 years

Table 7: Atmospheric Lifetimes of CFCs

Assessment Panels of the Montreal Protocol' report, the stratospheric abundances of ozone-depleting gases were in 2002 at or near a peak, while the Antarctic ozone 'hole' is expected to disappear by the year 2050. This expected improvement will, however, not be reflected in the ISEW methodology as long as the costs of ozone depletion are linked to the cumulative emission flows. Therefore, I would propose to link the costs of ozone depletion to the stock (or concentration) of ozone depleting substances in the atmosphere.

Within the updated SISEW methodology, both items that keep track of long-term environmental damage are calculated using data on historical emission rates of the different pollutants and estimates of the marginal social costs attributed to these emissions. Where these items were calculated originally using cumulative emission data, here I have opted to use supplemental data on the atmospheric lifetimes of the pollutants. A linear depreciation model is used and the atmospheric stock of the emitted pollutants in year  $i$  is given by:

$$stock_i = \sum_{j=0}^{\alpha} \left[ emissions_{i-j} * \left( \frac{\alpha - j}{\alpha} \right) \right] \quad (5.1)$$

with  $\alpha$  the atmospheric lifetime of the pollutant.

As the IPCC (2001) suggests a range of 5 to up to 200 years for the atmospheric lifetime of  $CO_2$ , a central value of 100 years is used in the updated ISEW. The marginal social cost estimate used for 1990 from was taken from Jackson et al. (1997) and spread throughout the period of the Dutch SISEW study by linking this estimate to the atmospheric carbon dioxide concentration as measured in Mauna Loa, Hawaii (through the differences with the pre-industrial levels of  $CO_2$  concentration). The time series of  $CO_2$  emissions data is, for now, extended beyond 1960 using Belgian data, as I am unable to find these data for the Netherlands. Yet, as these emissions data are probably lower than the ones for the Netherlands (due to differences in population size), I consider the estimates of the costs of climate change to be reasonably moderate. However, I hope to obtain more reliable data in the future.

Data on the consumption of CFCs are aggregated using ozone depleting potential (ODP) equivalents. Given the composition of the CFC emissions for Europe and the atmospheric lifetimes of the different types of CFCs (WMO, 1994), an estimated lifetime of 80 years is employed in the adjusted ISEW methodology (see table 7). Conversion of the cost estimate used in Jackson et al. (1997) has led to a fixed unit cost of €53 (2000€) per kilogramme of CFC equivalent, which is applied to the total 'stock' of CFCs in the atmosphere.

## Public Consumption Expenditures

Within the original ISEW methodology, public expenditures are considered to be mainly defensive: “the growth of government programs does not so much add to net economic welfare as prevent deterioration of well-being by maintaining security, environmental health and the capacity to continue commerce” (Daly and Cobb, 1989). Only half of the expenditures on higher education and on health are considered as consumption and hence contributing to welfare, as most of these expenditures are thought of as investments in human capital (which is not included in the ISEW framework). Although this methodology is used in most international ISEW studies, some exceptions exist. In the calculation of the Genuine Progress Indicator (GPI) for Australia (Hamilton and Denniss, 2000), for instance, substantially more public expenditures are considered to promote welfare.

In my opinion, consumption expenditures made by a government add more to economic welfare than accounted for in the original methodology. Therefore, I have added more categories of public consumption expenditures to the index: business services (50%), general governance, defense and social services (25%), health (50%), education (50%) and other services (50%). These figures are based on Hamilton and Denniss (2000).

### 5.4 An Adjusted SISEW for the Netherlands

In this section, the impact of the adjustments made to the original methodology on the results of the Dutch SISEW case study is looked into. Figure 11 illustrates the overall effect of all adjustments on the three versions of the SISEW as outlined in section 2. The SISEW(new) indexes show a different trend over time than the SISEW indexes presented in section 4. Some interesting conclusions emerge. First, we notice an overall increase over the period 1971-2004. Second, whereas per capita economic welfare more or less stayed at a constant level in the 1970s and 1980s, in the 1990s the Netherlands have witnessed a sharp increase. In the early 2000s, a new period of stagnation appears to be setting in. Third, all three versions of the SISEW display the same trend over time. SISEW1(new)/capita is plotted against the original SISEW1/capita index in figure 12.

In figure 13 the individual impacts of the adjusted valuation methods are examined. The ISEW1/capita line is taken as a baseline. Leaving out both the ‘net capital growth’ item and the ‘changes in the net international investment position’ item, results in the ‘Omissions’ line, which shows a similar trend over time than the original SISEW1/capita, yet has a smoother course than the latter (as the two omitted items have data sets with high levels of variation).

The new valuation method for natural capital depletion has the most striking impact on the index. As the costs of replacing a barrel of oil equivalent of non-renewable energy are kept constant over time instead of using an escalation factor of 3% per year, the use of non-renewables before 1988 - the year for which the replacement cost was estimated by Cobb and Cobb (1994) - is valued higher, while the opposite is true for the years after 1988. The ‘Natural Capital Depletion’ line is thus situated below the baseline prior to 1988 and above afterwards.

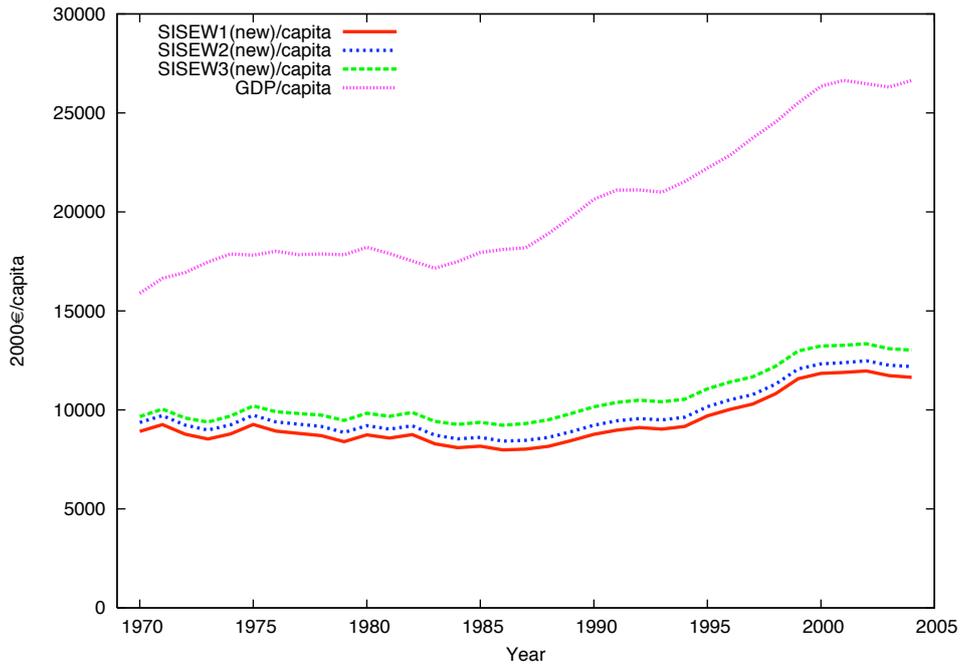


Figure 11: SISEWs with Adjusted Methodology

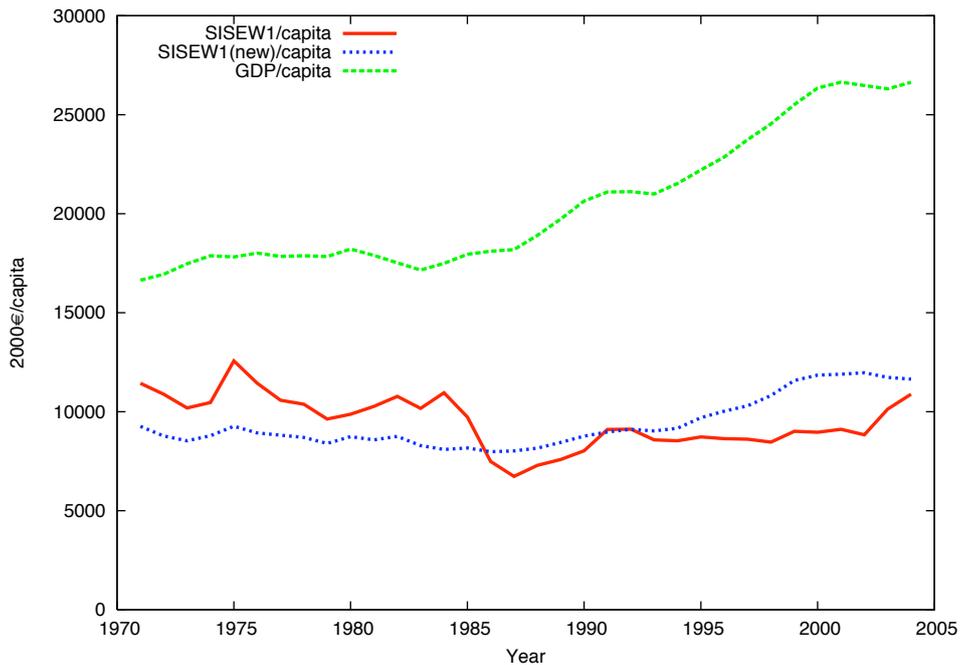


Figure 12: SISEW1/capita - Old versus New

The other proposed adjustments to the valuation methods used in the ISEW methodology have less marked impacts, as they shift the baseline index upwards or downwards. The new valuation method for the long-term environmental damage caused by climate change results in higher estimates of the associated costs, as linking the original 1990 marginal social cost estimate (Jackson et al., 1997) to actual carbon dioxide concentrations leads to higher MSC estimates in the later years of the case study.

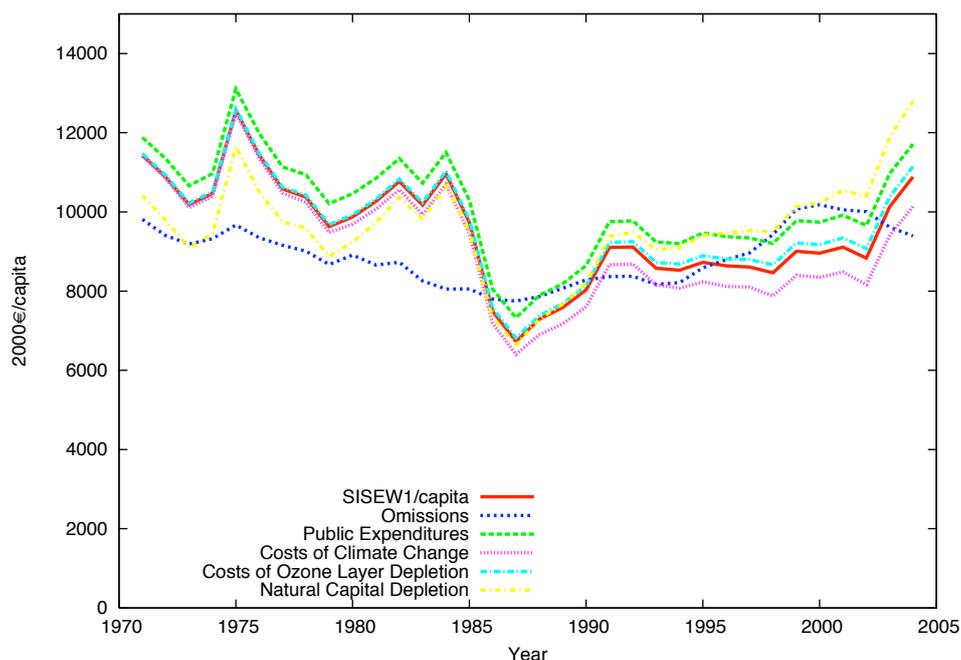


Figure 13: Impacts of Individual Adjustments

Accounting for more types of public consumption expenditures evidently results in an upward shift of the per capita ISEW. The new stock-based valuation method for ozone layer depletion has the same effect, as it allows for an outward flow of ozone depleting substances from the atmosphere, where previously all emissions were endlessly accumulated.

## 6 Conclusions

This report reviews the compilation of a Simplified Index of Sustainable Economic Welfare (SISEW) for the Netherlands for the period 1971-2004. The SISEW is a simplified version of the Index of Sustainable Economic Growth (ISEW) by Daly and Cobb (1989) in that it is compromised of fewer items. Based on the ISEW case study for Belgium, a restrictive criterion is applied to the methodology of the index which omits items with low quantitative significances. This allows for monitoring sustainable economic welfare using less data than previously needed. Depending on the level of restrictiveness, 9 to 13 items need to be calculated in order to arrive at the SISEW (instead of the 20 needed in the compilation of the ISEW).

A number of interesting conclusions can be drawn from the SISEW case study on the Netherlands. First, the 2004 level of economic welfare per capita (as measured by the SISEW) is almost the same as the 1971 level and this while GDP/capita shows an almost continuous increase over the same period. Second, looking at the trend over time, it is possible to split the period analyzed into two shorter ones: a period of decline in economic welfare up to 1987 when SISEW/capita reaches its period low, and one of rising economic welfare levels afterwards. Third, all three SISEW versions (each one using a different level of restrictiveness) show more or less the same trend over time (with the one exception being SISEW3 in the pe-

riod 1995-2000, when the Netherlands witnessed a dramatic decrease in its net international investment position).

The compilation of an Index of Sustainable Economic Welfare (simplified or not) is a valuable exercise, given the importance of its underlying rationale and the potential of the index as a communication tool. The (S)ISEW offers an ideal way to make people understand the different effects that economic growth can have on human welfare. The index is also appreciated because it provides an empirical translation of the critiques on the GDP when used as a welfare measure.

However, as there is no widespread consensus on the methodology of the index, international acceptance is still some way off. Efforts at a national level are helpful in screening different welfare-related issues and their valuation methods and can lead to new understandings of measuring economic welfare. The ongoing debate caused by such exercises will also be of high value for the further development of welfare measures. It should also be noted that many authors appreciate the ISEW more as a first step towards a better measure for economic welfare than as the 'ideal' indicator of national welfare. The compilation of (S)ISEWs allows for the start of a learning process, which may eventually lead to a methodology that is internationally agreed upon.

A first proposal for adopting an adjusted methodology was put forward in Bleys (2007). Here, it is shown that properly separating capital stocks and flows of services can help to overcome one of the most widely criticized methodological inconsistencies surrounding the ISEW. The adjusted Index of Sustainable Economic Welfare, which omits the 'net capital growth' and the 'changes in the net international investment position' items, tracks the different flows of services that consumers enjoy and is thus a measure of current economic welfare. Supplemental stock accounts can provide information about the durability of the current level of economic welfare. These accounts can include human-made and natural capital accounts and an account that highlights international dependencies. Some of the more problematic valuation methods within the ISEW framework are also tackled in the adjusted methodology, as new methods are used to calculate the costs of climate change and ozone layer depletion, the non-defensive public expenditures and the natural capital depletion item.

Applying this updated methodology to the SISEW case study for the Netherlands offers some interesting conclusions. First, an overall increase in per capita economic welfare is found over the period 1971-2004. Second, whereas economic welfare more or less stayed at a constant level in the 1970s and 1980s, in the 1990s the Netherlands have witnessed a sharp increase. In the early 2000s, a new period of stagnation appears to be setting in.

The different conclusions resulting from the 'original' and the 'adjusted' SISEW compilations underline the importance of the underlying assumptions within the methodological framework of the index. The most important ones seem to be whether or not one should use an escalation factor in estimating the replacement costs of depleted non-renewable resources and whether or not the costs of long-term environmental damage are accounted for based on cumulative emissions.

It is therefore extremely important that a widely accepted and more robust set of valuation methods is established in the near future, in order to add to the validity of the (S)ISEW as a proper measure of economic welfare. Yet, as the development of such a set might take some time, for now, (S)ISEW studies should clearly stress all assumptions made within the framework of the index and warn against interpreting the results too literally.

## **7 Appendix**

### **A Simplified ISEW for the Netherlands, 1971-2004**

Tables 8 and 9 present the final monetary estimates of the different items that enter the methodology of the Dutch SISEW. Except for columns A, P, R, T, V and W, all columns are expressed in million 2000€ (constant prices). Columns P, R, T and V are given in constant 2000€/capita, while column W is given in thousand people.

The valuation methods and the data used to determine the estimates given in the tables below are described to a greater length in section 3.

Column O, the Simplified Index of Sustainable Economic Welfare (SISEW1), is calculated by adding columns D, E, M and N to column B, while subtracting columns C to L. Column Q (SISEW2) is derived analogously, by adding columns D, E, M and N to column B, while subtracting columns C, D, E, G, I, J, K and L). Finally, Column S (SISEW3) is calculated by adding columns D, E, and M to column B, while subtracting columns C, D, E, I, J, K and L.

A	B	C	D	E	F	G	H	I	J	K	L
Year	Personal Consumption Expenditures	Losses from Income Inequality	Value of Household Work and Education	Public Expenditures on Health	Private Defensive Expenditures	Costs of Commuting	Costs of Water Pollution	Costs of Air Pollution	Depletion of Non-Renewable Resources	Costs of Climate Change	Costs of Ozone Layer Depletion
1971	111827.1	8829.8	60863.7	10451.6	3069.3	1460.9	2900.2	11844.3	11321.8	3439.2	3439.2
1972	113329.1	8624.5	60396.4	11029.2	3110.5	1480.5	2900.2	12543.7	11971.0	3890.8	3890.8
1973	117578.2	8611.8	57826.5	11399.9	3227.1	1536.0	2900.2	12718.2	12659.0	4418.7	4418.7
1974	120257.7	8539.9	58371.2	12264.8	3300.7	1571.0	2900.2	12312.9	13335.8	4986.3	4986.3
1975	123438.5	8490.6	60482.8	13217.9	3388.0	1612.6	2900.2	11764.9	14008.4	5458.3	5458.3
1976	127344.4	8671.9	58633.2	13517.9	3495.2	1663.6	2900.2	12197.2	14751.3	5984.0	5984.0
1977	128044.2	8474.6	56511.0	13718.8	3514.4	1672.7	2900.2	11669.8	15501.1	6474.7	6474.7
1978	130194.0	8754.3	55703.1	14087.9	3573.4	1700.8	2900.2	11577.6	16297.7	6953.0	6953.0
1979	130873.9	8777.6	54844.2	14545.1	3592.1	1709.7	2900.2	11670.5	17177.2	7410.0	7410.0
1980	133976.9	8916.8	55443.3	14915.1	3677.2	1750.2	2885.7	10954.2	18073.4	7875.0	7875.0
1981	129792.4	8931.4	56797.9	14877.7	3562.4	1695.6	2871.2	10302.9	18932.7	8342.9	8342.9
1982	127806.4	8352.7	57794.2	14826.5	3507.9	1669.6	2856.7	9333.7	19600.7	8781.7	8781.7
1983	125668.5	8126.7	57296.2	14391.7	3449.2	1641.7	2842.2	9291.7	20291.0	9273.3	9273.3
1984	127809.3	8572.0	57393.6	14030.6	3507.9	1669.6	2827.7	9346.7	21053.5	9831.7	9831.7
1985	131478.9	8709.4	56670.9	14493.3	3608.7	1717.4	2813.2	9141.9	21883.5	10408.5	10408.5
1986	132390.4	9424.2	56615.4	14612.9	3633.7	1765.1	2798.6	9088.0	22679.2	11082.3	11082.3
1987	135463.3	9875.3	56317.2	15353.4	3718.0	1881.2	2784.1	8915.9	23506.4	11784.6	11784.6
1988	138687.3	10062.7	57165.0	15677.7	3806.5	2000.5	2769.6	8541.9	24323.6	12494.4	12494.4
1989	143718.0	10379.6	58751.4	15954.9	3944.6	2138.5	2713.3	8294.7	25302.1	13038.2	13038.2
1990	150659.7	12404.4	58297.7	16540.3	4135.1	2137.1	2741.7	8320.6	26237.3	13355.5	13355.5
1991	156282.9	12820.5	59521.3	17212.7	4289.5	2165.3	2780.7	8060.5	27260.9	13584.6	13584.6
1992	157380.1	12862.7	60775.4	17821.3	4319.6	2337.5	2576.1	7705.1	28295.3	13783.5	13783.5
1993	157481.3	13303.1	61138.4	18118.1	4322.3	2234.7	2723.9	7444.3	29392.1	13949.1	13949.1
1994	161237.9	13166.2	61662.4	18335.7	4425.5	2352.6	2682.9	7175.6	30430.4	14036.9	14036.9
1995	167565.1	13198.3	65639.9	17824.7	4559.6	2427.6	2663.8	6608.0	31533.8	14073.7	14073.7
1996	175801.7	14666.7	67397.5	17756.6	4907.7	2583.1	2629.6	6846.2	32766.2	14103.2	14103.2
1997	181358.2	14756.5	65638.3	18458.8	4833.0	2712.5	2616.1	6424.8	33960.5	14129.6	14129.6
1998	190904.4	16530.1	66904.8	19271.3	5041.7	3150.6	2549.0	6131.6	35192.9	14153.7	14153.7
1999	201101.4	17491.3	68870.7	20241.2	5221.1	3527.1	2477.5	5738.2	36423.7	14178.7	14178.7
2000	207311.0	19857.1	69147.5	21182.0	5214.0	3617.7	2420.3	5402.2	37647.8	14209.0	14209.0
2001	209767.8	18461.4	69947.1	22359.7	5432.9	3442.1	2402.6	5210.4	38935.2	14214.9	14214.9
2002	209841.4	19034.0	73124.6	23862.5	5874.3	3510.7	2335.8	5067.6	40246.4	14218.3	14218.3
2003	207822.9	19150.1	74704.5	24787.4	6191.1	3305.3	2331.6	4947.2	41605.2	14229.5	14229.5
2004	208129.2	21136.3	76098.0	25420.7	6552.9	3518.4	2327.7	4811.0	43010.8	14231.1	14231.1

Table 8: The Simplified Index of Sustainable Economic Welfare for the Netherlands, 1971-2004

M	N	O	P	Q	R	S	T	U	V	W
Net Capital Growth	Change in NIIP	SISEW1	Per Capita SISEW1	SISEW2	Per Capita SISEW2	SISEW3	Per Capita SISEW3	GDP	Per Capita GDP	Population
21288.0	0.0	149999.8	11433.4	155969.3	11888.4	157430.1	11999.8	218347.0	16643.0	13119.4
19618.0	0.0	144389.5	10881.3	150400.2	11334.2	151880.7	11445.8	224790.5	16940.3	13269.6
13349.9	0.0	136359.7	10185.5	142487.0	10643.2	144022.9	10757.9	233890.8	17470.7	13387.6
15409.7	0.0	141195.7	10465.9	147396.5	10925.5	148967.5	11042.0	241221.4	17880.1	13491.0
39380.5	0.0	170876.0	12565.2	177164.1	13027.6	178776.6	13146.2	242323.5	17819.1	13599.1
28722.5	0.0	157122.6	11440.8	163518.0	11906.4	165181.5	12027.6	247386.8	18013.3	13733.6
19685.6	0.0	146191.0	10582.4	152605.6	11046.8	154278.3	11167.9	246531.9	17845.9	13814.5
18994.4	0.0	144184.4	10374.6	150658.0	10840.4	152358.8	10962.7	248489.2	17879.7	13897.9
13395.5	0.0	134676.8	9629.7	141169.1	10093.9	142878.7	10216.2	249469.4	17837.7	13985.5
13528.6	0.0	139106.3	9872.0	145669.1	10337.7	147419.4	10461.9	256646.8	18213.5	14091.0
22826.3	0.0	145882.8	10267.2	152316.3	10720.0	154011.9	10839.4	254313.6	17898.6	14208.6
29177.0	0.0	153885.7	10771.9	160250.2	11217.4	161919.8	11334.3	250319.3	17522.2	14285.8
27415.7	0.0	145837.2	10170.3	152128.6	10609.0	153770.3	10723.5	246024.3	17157.0	14339.6
24531.2	17309.3	157753.6	10959.2	164089.2	11399.4	148449.6	10312.9	251848.3	17496.0	14394.6
11529.2	12708.1	140690.8	9733.8	147112.6	10178.1	136121.9	9417.7	259507.1	17954.2	14453.8
-9118.9	4608.9	108802.2	7488.4	115234.5	7931.1	112390.8	7735.4	263062.0	18105.5	14529.4
-18939.3	4043.9	98376.0	6731.1	104878.2	7176.0	102715.5	7028.0	265788.8	18185.9	14615.1
-11728.7	3341.9	107324.0	7293.5	113900.2	7740.4	112558.7	7649.3	278215.6	18907.0	14714.9
-7916.1	727.9	112325.9	7586.9	118983.8	8036.6	120394.5	8131.9	292197.6	19736.1	14805.2
-1527.2	-2284.2	119557.4	8028.0	126434.2	8489.7	130855.6	8786.6	307412.1	20642.0	14892.6
10368.0	707.0	136656.9	9104.1	143727.0	9575.1	145185.3	9672.3	316678.9	21097.2	15010.4
13700.0	-2498.7	137909.1	9115.5	144804.8	9571.2	149640.9	9890.9	319391.2	21111.0	15129.2
6983.7	-776.0	130714.1	8577.5	137760.3	9039.9	140771.0	9237.4	319973.0	20996.7	15239.2
5880.6	-1078.6	130843.1	8528.7	137951.5	8992.0	141382.7	9215.7	330292.3	21529.3	15341.6
3325.9	-1198.8	134576.0	8725.0	141799.3	9193.3	145425.7	9428.5	342610.6	22212.6	15424.1
3484.9	-5907.8	133827.0	8637.4	141364.3	9123.9	149855.1	9671.9	354272.5	22865.3	15493.9
-1002.3	-4532.6	134013.4	8608.8	141462.4	9087.3	148707.5	9552.7	369572.5	23740.6	15567.1
-937.2	-14117.0	132511.7	8464.9	140102.4	8949.8	157369.9	10052.9	384116.9	24537.6	15654.2
1226.5	-18042.7	141949.9	9006.8	149648.5	9495.3	171218.2	10863.9	402026.9	25509.0	15760.2
3997.4	-23411.4	142133.3	8959.5	149767.6	9440.8	176796.8	11144.6	417960.0	26346.5	15864.0
3314.5	-18390.3	145669.7	9111.7	153505.2	9601.8	175337.6	10967.5	426004.8	26646.8	15987.1
10307.1	-29192.0	142255.5	8832.8	150465.6	9342.6	183168.2	11373.2	426434.9	26477.9	16105.3
16874.1	-8474.5	164110.0	10134.9	172632.7	10661.2	184412.5	11388.7	425991.9	26307.9	16192.6
23176.5	1104.2	176974.6	10885.4	185855.2	11431.6	188269.4	11580.1	433087.5	26638.4	16258.0

Table 9: The Simplified Index of Sustainable Economic Welfare for the Netherlands, 1971-2004 - continued

## References

- Anielski, M. and Rowe, J. (1999). *The Genuine Progress Indicator - 1998 Update: Data and Methodology*, Redefining Progress, San Francisco, CA.
- Atkinson, A. (1970). On the Measurement of Inequality, *Journal of Economic Theory* **2**(3).
- Atkinson, A. (1975). *The Economics of Inequality*, Oxford University Press, Oxford, UK.
- Bleys, B. (2006). The Index of Sustainable Economic Welfare for Belgium: First Attempt and Preliminary Results, *MOSI Working Paper*, number 27, Vrije Universiteit Brussel, Brussel, Belgium.
- Bleys, B. (2007). The Index of Sustainable Economic Welfare for Belgium: Proposed Adjustments to the Methodology, *Internal MOSI Document*, Vrije Universiteit Brussel, Brussel, Belgium.
- Breedveld, K., van den Broek, A., de Haan, J., Harms, L., Huysmans, F. and van Ingen, E. (2006). *De Tijd als Spiegel*, Sociaal en Cultureel Planbureau, Den Haag, the Netherlands.
- Clarkson, R. and Deyes, K. (2002). *Estimating the Social Cost of Carbon Emissions*, Department of Environment, Food and Rural Affairs (DEFRA), London, UK.
- Cobb, C. and Cobb, J. (1994). *The Green National Product: A Proposed Index of Sustainable Economic Welfare*, University Press of America, Lanham, MD.
- Cowell, F. and Gardiner, K. (1999). *Welfare Weights*, London of Economics: STICERD Working Paper, London, UK.
- Daly, H. and Cobb, J. J. (1989). *For the Common Good. Redirecting the Economy toward Community, the Environment and a Sustainable Future*, Beacon Press, Boston, MA.
- Downing, T. and Watkiss, P. (2004). *The Social Costs of Carbon in Policy Making: Applications, Uncertainty and a Possible Risk Based Approach*, DEFRA - Department for Environment, Food and Rural Affairs, London, UK.
- Fankhauser, S. (1994). The Social Cost of Greenhouse Gas Emissions: an Expected Value Approach, *The Energy Journal* **15**(2): 157–184.
- Hamilton, C. and Denniss, R. (2000). *Tracking Well-Being in Australia: The Genuine Progress Indicator 2000*, The Australian Institute, Canberra, AU(ACT).
- Hamilton, K. and Atkinson, G. (1996). Air Pollution and Green Accounts, *Energy Policy* **24**(7): 675–684.
- Holland, M., Pye, S., Watkiss, P., Droste-Franke, B. and Bickel, P. (2005). *Damages per tonne Emission of PM2.5, NH3, SO2, NOx and VOCs from each EU25 Member State (excluding Cyprus) and Surrounding Seas*, AEA Technology Environment, Didcot, UK.

- IPCC (2001). *Climate Change 2001. The Scientific Basis*, Cambridge University Press, Cambridge, UK.
- Jackson, T., Marks, N., Ralls, J. and Stymne, S. (1997). *Sustainable Economic Welfare in the UK, 1950-1996*, New Economics Foundation, London, UK.
- Jackson, T. and Stymne, S. (1996). *Sustainable Economic Welfare in Sweden: A Pilot Index 1950-1992*, Stockholm Environmental Institute, Stockholm, Sweden.
- Lawn, P. (2003). A Theoretical Foundation to Support the Index of Sustainable Economic Welfare (ISEW), Genuine Progress Indicator (GPI), and Other Related Indexes, *Ecological Economics* **44**(1): 105–118.
- Lawn, P. (2005). An Assessment of the Valuation Methods Used to Calculate the Index of Sustainable Economic Welfare (ISEW), Genuine Progress Indicator (GPI), and Sustainable Net Benefit Index (SNBI), *Environment, Development and Sustainability* **7**(2): 185–208.
- Lawn, P. (2006). An Assessment of Alternative Measures of Sustainable Economic Welfare, in P. Lawn (ed.), *Sustainable Development Indicators in Ecological Economics*, MPG Books, Bodmin, UK, pp. 139–165.
- Leipert, C. (1989). Social Costs of the Economic Process and National Accounts: The Example of Defensive Expenditures, *Journal of Interdisciplinary Economics* **3**(2): 27–46.
- Max-Neef, M. (1995). Economic Growth and Quality of Life: a Threshold Hypothesis, *Ecological Economics* **15**(2): 115–118.
- Neumayer, E. (1999). The ISEW: Not an Index of Sustainable Economic Welfare, *Social Indicators Research* **48**(1): 77–101.
- Neumayer, E. (2000). On the Methodology of ISEW, GPI and Related Measures: Some Constructive Suggestions and Some Doubt on the 'Threshold' Hypothesis, *Ecological Economics* **34**(3): 347–361.
- Pearce, D. and Ulph, D. (1995). *A Social Discount Rate for the United Kingdom*, CSERGE Working Paper 95-01, CSERGE, University College London, London, UK.
- Reid, M. (1977). How New is the 'New Home Economics'?, *Journal of Consumer Research* **4**(3): 181–183.
- SNA (1993). *System of National Accounts, 1993*, United Nations - Working Group on National Accounts, New York, NY.
- Thurow, L. (1975). Education and Economic Inequality, in D. Levine and M. Bane (eds), *The Inequality Controversy: Schooling and Distributive Justice*, Basic Books, New York, NY, pp. 99–99.
- UNEP (1999). *Production and Consumption of Ozone Depleting Substances 1986-1998*, United Nations Environment Programme: Ozone Secretariat, Nairobi, Kenya.

WMO (1994). *Scientific Assessment of Ozone Depletion: 1994*, World Meteorological Organisation, Geneva, Switzerland.

